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OVER-IRRIGATING RICE.

At the Meeting of the Board of Agriculture at Galle on November 30th last considerable interest was taken in MR. CORLETT'S description of the system of water control established by him on the paddy fields of the Experiment Station, Peradeniya, and of the satisfactory results that have been so far achieved. MR. CORLETT has introduced from Egypt several departures from established Ceylon practice among them being dry ploughing and green manuring between crops. The seed sown on the experiment plot was from that evolved by DR. LOCK, carefully selected each year since it was first introduced; only plants with 15 or more stems to a stool being set apart for seed. In previous years this method of selection has not produced any very striking effect; time is required for that. The wonderfully good crop that has been produced at Peradeniya must be set down mainly to the fact that the irrigation water has been kept under control and the land has not been allowed to become water-logged.

In his paper on the Irrigation of Rice in Ceylon read before the Ceylon Agricultural Society on May 25th, 1915, MR. BALFOUR stated that according to experiments carried out by him in the North-Central Province a three-months' crop of paddy required in one case 41 inches and in another 47 inches of water, and that from these and other data it appeared that on average paddy lands 16 inches were required for the first month and 12 inches for each succeeding month. In his excellent series of articles on the cultivation of Paddy in Ceylon during the nineteenth century which appeared in this Journal in 1912-14, MR. ELLIOTT did not, it is to be regretted, go into this question of quantity of water required, so important to the villager. His views on the amount of water used by the cultivator as

compared with the amount required would have been valuable. Generally speaking, more water is used by the villager on his paddy field than is necessary for crop nutrition, with the result that the land gets water-logged and hence soured. Good irrigation postulates a system of drains as well as of canals, but the paddy fields of Ceylon are not drained in the proper sense of the word. A breach is made in the bund and the water led off the surface, but that in the body of the soil does not escape. At Peradeniya a drain 20 inches deep is cut through the field from the top to the outlet. The water from the soil is drained away to a corresponding depth, its place being taken to a great extent by air from the atmosphere which contains oxygen, necessary for the process of plant nutrition. This is really the secret of the success of the Peradeniya fields. When water from beneath the surface cannot drain away oxygen from the atmosphere cannot enter, nitrification and plant nutrition is arrested and the paddy turns yellow—an unfailing indication of water-logged land.

The yield of the Peradeniya field in the corresponding period of last year was at the rate of 33 bushels per acre. The crop this year has not yet been threshed but the yield is estimated at 50 bushels, 50 per cent. more than that obtained from the land before the present system of canals and drains was introduced. During the first two weeks, when the crop was young, water was allowed to stand to the depth of 2 inches, being renewed every 2 or 3 days as it soaked in; if it had not disappeared in 3 days it was drawn off. Thus for the first fortnight 4 to 6 inches of water a week was used. After that water to the same depth was allowed to stand 6 days when it was drawn off and the land given a day to dry. This is repeated till within about 6 weeks of harvest when the drying interval is extended to 3 days alternating with 3 days water. Thus after the first fortnight water is never allowed to stand more than 2 inches deep; during the subsequent 3 months (with a 5-months' crop as this is) the land is left without water one day a week; after that for half the time the crop has no standing water at all.

Ceylon practice varies, so it is not possible to describe in a short article the systems of water control in vogue, but we believe there is nothing that corresponds to the system of drainage and dry intervals outlined above. The cry of the villager is for more water and in some cases no doubt there is a genuine shortage; but more often his necessity is in reality for more air.

R. N. L.

RUBBER.

A NEW BULLETIN ON RUBBER TAPPING.

We have received the Federated Malay States Department of Agriculture Bulletin No. 23 on "The Tapping of the Para Rubber Tree" by MR. E. BATESON, which Bulletin contains so much of interest to those who study the technical problems connected with rubber tapping that it is desirable to discuss it at some length. In a short preface MR. LEWTON BRAIN remarks that the delay in publishing is due to MR. BATESON'S absence from the country and the consequent difficulties in correspondence and correcting proofs. Doubtless to these difficulties is also due the fact that the Bulletin in question, though appearing late in 1915, bears as year of publication the date 1914, though it is desirable that publications such as these should bear the actual date of issue. The Bulletin is of especial interest in that a large amount of the work described therein is upon similar lines to work recently carried out in Ceylon.

MR. BATESON'S work covers a large area, perhaps too large an area to be fully dealt with in one Bulletin. The investigations are divided into six main sections, dealing with the effect of tapping on the starch reserves, effect of leaf change on the starch reserves, lateral transport of food in bark, tapping systems, theory of tapping and finally a section on "some practical considerations as regards the effect of tapping on the starch reserves." MR. BATESON came to the conclusion that "if any depletion of the starch reserves is caused by tapping, it is small in amount and temporary in duration."

In this, the work is in fair accord with results obtained in Ceylon by the writer of this article, and MR. BATESON after describing the investigations of FITTING'S remarks that he finds it hard to understand how FITTING obtained his results. Many of FITTING'S theories have now been proved to be fallacious by three independent investigators, namely SIMON, BATESON and the writer.

MR. BATESON concludes this section by rejecting FITTING'S suggestion that an examination of the starch reserves would be a useful method of determining when trees are ready to be retapped after the whole of the original bark has been removed. As a result of his investigations MR. BATESON concludes that "such examinations are unnecessary and that the thickness of the renewed bark forms a perfectly safe criterion."

With regard to the effect of leaf-change on the starch reserves, MR. BATESON remarks that the facts elicited by his research are somewhat too meagre, on account of the small number of trees examined, to enable precise conclusions to be drawn on the points of theoretical interest. He deduced, however, that in the Federated Malay States the effects of wintering are spread over such a long period that they merely form part of the general problem of devising a method of tapping, which, over a period of years, will not be so exhaustive to the tree as to check its full and natural development. The writer of this article is inclined to question the value of these deductions in that MR. BATESON apparently examined his trees at only quarterly intervals.

Now in Ceylon we examined trees throughout the year at monthly intervals, and during the period March 12th—May 7th, no less than six or seven sections were taken from each tree. By thus carefully following the various changes attendant upon fall of the old leaves and formation of the new, we found that a considerable depletion of reserve starch occurs on the formation of new leaf, which depletion is, however, only of short duration, fresh reserves being rapidly formed by the new leaves and accumulating up till May—June, after which the supply fell again somewhat until October. Had we contented ourselves by taking sections in say March, April, July, October we should have come to the same conclusion as MR. BATESON, who however, somewhat disarms the critic by remarking in a footnote (page 9) that "it would have been better if several trees could have been examined in all stages of wintering, viz : before the leaves were shed, when the trees were bare and after the new foliage had developed. This, however, would have meant taking the first specimens of wood and bark from an inconveniently large number of trees, as it was not then known which would winter." We hope that detailed investigations of this nature will be forthcoming from the Federated Malay States.

It is of course quite possible that the changes taking place in trees in Ceylon will differ widely from those taking place in trees in other parts of the tropics. With regard to lateral transport of food in bark the experiments showed that lateral translocation of food is possible.

In all his tapping experiments MR. BATESON describes only three systems, namely the single-quarter system with two cuts on one quarter, the adjacent quarter system with one cut on each of two quarters, and the opposite quarter system with one cut on each of two quarters. He found that the bark of the trees tapped by the adjacent quarter system contained more starch than the bark of the other trees, and that the thickness of renewing bark was greater. With regard to rubber yield the single-quarter system was better by 16% and the adjacent quarter system by 31% than the opposite quarter system, while the adjacent quarter system yielded 13% more than the single-quarter system.

There is much of interest in the final section of the pamphlet. MR. BATESON states that in his opinion there is no doubt that if trees growing in a soil of average fertility are allowed sufficient space, four years will be found quite long enough for bark renewal.

MR. BATESON's remarks on thinning-out, burr-formation, etc., are of such interest that it is desirable to discuss them at length in the next issue of this Journal.

L. E. C.

(To be continued.)

MR. L. C. BROWN of the F.M.S., writing about coconut planting, says :—"I may mention, after my long experience of the coconut industry, that to produce really healthy and productive trees I consider the most critical stage of the plant is in its earlier life, i.e. from infancy up to the 3rd or 4th year, and during this period the most careful attention must be exercised."

COFFEE.

ROBUSTA COFFEE IN JAVA.

Coffea Robusta is now the favorite Dutch East Indian crop, and it is being freely prophesied that many fancy growths are doomed to extinction because of its advent. "Considerable variation is to be found in the opinions expressed as to the quality of Robusta coffee," says TROPICAL LIFE, "but it is not improbable that such differences are in some measure to be explained as a result of different methods of preparation, not all of equal excellence. It is stated that the beans do not possess a first-class color, and that for the first two crops a good aroma is lacking. DR. WILDEMAN affirms that the flavor recalls that of Liberian coffee, but with less aroma. HART compared Robusta coffee of Costa Rica and the East Indies; while, according to CRAMER, the quality of well-prepared Robusta coffee is approximately that of middling Arabian coffee. The beans possess a bluish green color, similar to that of the Arabian product, but they are of a somewhat different shape being larger and more convex on the curved side."

Writing on the subject of Robusta coffee (*Coffea canephora*) in the PHILIPPINE AGRICULTURAL REVIEW, P. J. WESTER strongly recommends the growing of this variety of coffee in altitudes of under 1,200 feet. It is much superior to Arabian coffee in its yield; it is an early as well as a prolific bearer, and is more resistant to blight. Although the flavor of Robusta coffee is stated to be inferior to that of the Arabian variety, MR. WESTER considers that this alleged defect is not sufficient to counterbalance its general advantages.

Coffea robusta, DR. CRAMER considers to be identical with *Coffea laurentii;* this species is as distinct from *Coffea arabica* and *Coffea liberica* as these are different from one another, and requires conditions quite other than those needed by these for its proper growth. In the history of the distribution of the species it was first obtained from Brussels in 1900 for planting in the east and centre of Java, where it was considered as a curiosity until two years later, when its large power of production came under observation. Since 1907 there has been a great extension of the area of *Coffea robusta* in Java. No other kind of coffee is being planted at present to any extent in Java or other islands in the Dutch East Indies.

Experiments in Java show that this coffee will flourish from sea-level to an altitude of 3,000 feet. The best plantations are found in the humid districts of East Java, where there is a large rainfall distributed equally during the year. These estates are situated from 1,000 to 1,500 feet above sea-level, and the soil is deep and rich in vegetable matter. The plant is capable of resisting drought to a certain degree, but prefers an abundant and regular rainfall. In the south of Java it has survived a dry period lasting nearly four months; the trees suffered to some extent, but recovered very quickly after the first rain. In Java, Robusta coffee is always planted under shade; in

connection with this, the shade given by Para rubber trees would be insufficient on account of its inequality and its absence for part of the year owing to the loss of the leaves. The plant suffers severely if exposed to the wind, and where such exposure is likely to occur it is useless to attempt to grow it unless measures are taken for its protection.

TIME OF FLOWERING AND YIELD.

The first flowering takes place a year after planting, though cases are known in Sumatra when the period has been eight months; in the latter case sterile flowers were formed after seven months, and the normal flowers appeared a month later. After flowering, the time for the formation of ripe fruits may be taken as nine months; thus trees of the latter kind would yield a harvest in two years. The plant flowers during the whole of the year resembling *Coffea liberica;* nevertheless, the climate has some effect on production, and the crop is increased in amount during the dry season; the berries remain on the branches for about a month, so that a monthly picking is necessary.

The berries are smaller than those of Liberian coffee, and are borne in thick bunches, so that picking is facilitated and hastened. The fruit covering is thin, and there is another advantage in that the skin is easily removed. The seeds are fermented for thirty-six hours and then washed and dried; for the last-named purpose they should be exposed immediately to a temperature of about 60 degrees C. The seeds are slightly different in shape, being larger and more convex than those of Arabian coffee. The bulk is about the same.

HOW COFFEE IS CULTIVATED.

Coffee in Netherlands East India is mostly grown on an elevation above sea level varying from 1,000 to 3,000 feet, though sometimes plantations exist higher than 3,000 and lower than 1,000 feet. It is not a plant for an obdurate soil; it thrives best on a loose, virgin soil, rich in decomposed organic matter and in a climate having a moderate, regular rainfall.

The ordinary procedure in Netherlands East India is to procure some forest or jungle having an area of at least 1,000 acres, which is felled, burnt and cleared so as to prepare it for planting. Nurseries have to be made for the coffee seedlings. Temporary houses have to be erected for the labour force, the manager and his staff. Roads have to be constructed. The cleared land, when ready for planting, is divided into regular squares or blocks, and these blocks are carefully lined so as to obtain regular rows when planted. At regular distances along these lines planting holes are dug deep enough to secure thorough aerating of the soil. Stones, roots and other obstructions found in the soil taken out of these holes have to be removed before the soil is returned to the holes. These refilled holes are to receive the seedlings. The transplanting of the seedlings is a painstaking and therefore a rather slow work. Hurrying it up would possibly avenge itself in after-time, for now the plants, as far as their roots are concerned, have to take care of themselves. As a protection for their leaves the coffee trees are interplanted with shade trees, for which *Leguminosæ* are chosen, in view of their capacity to fix nitrogen from the air. Planted at the same time as the coffee seedlings, and growing quicker than these, they will, when grown up, afford the coffee trees shade protection and act as wind-breaks.

WEEDING AND PRUNING.

In order to make the young coffee fully benefit by the fertility of the soil, clean weeding must be strictly adhered to, this system of weeding having at the same time the charitable effect that the soil is kept loose and well ærated. This, of course, involves continual expenditure for labor, etc., during the first three years.

When reaching the height of some 7 feet the tree is topped at about 6 feet from the ground, and kept at this height by regular pruning, it only being allowed to gradually renew itself by shoots from the rootcrown. The trees, when topped, are expected to strengthen and thicken their stems and their system of branches, these latter being their organism for fruit bearing. In consequence of this method of cultivation the coffee trees soon become bigger, and the thin, wide files now fill themselves to a dense, leafy mass covering the soil 6 feet high. In this period the tree's energy in making boughs, shoots and leaves has to be checked and directed into its fruit-bearing capacity, so the pruning knife comes into play.

THE RIPENING PROCESS.

Fruit bearing in normal conditions begins in the third year. The ripening process takes eight to nine months.

Liberian coffee bears fruits of the largest size, Robusta of the smallest size, and *Coffea arabica* fruits of a size ranking between these two. The various kinds of coffee are distinguished from each other by the color and the size of the kernels and the thickness of the outward peel. The color of Liberian coffee, when prepared, is yellowish-white, that of *Coffea arabica* bluish-green, and that of Robusta coffee grey. The peel is thickest and least elastic with Liberian coffee, thinnest and most elastic with *Coffea arabica*, and medium thick and elastic with Robusta coffee. With all three kinds it shows the state of ripeness of the fruit by assuming a fresh, red color.

PICKING AND PREPARATION.

As soon as the red color appears the crop is gathered and taken to the factory.

This factory consists of one or more iron-roofed sheds containing the necessary machines for pulping, washing and hulling the coffee. It has drying floors and a hot-house and godowns for storing the coffee. First of all the berries are pulped mechanically by means of compression between a system of revolving disks or drums under continuous supply of water, the water which flows off removing the empty peels, whereas a stream of fresh water washes the separated coffee beans into a tank. In this tank the beans are kept with a view to submitting them to a fermentation process. When separated from the peel the beans have a slimy appearance. This slime, which covers the parchment shell of the kernel, is decomposed by means of fermentation for a time, varying from 24 to 48 hours, depending on temperature and other circumstances. The duration of this fermentation process is controlled by tests.

The next process is to remove the last traces of the pulp and to get the beans in their parchment shell clean from dirt and waste, for which purpose the fermented coffee beans are washed by clean water into another big tank, where they are raked and kept in constant movement in clean water for

some hours until all adhering substances are separated and the kernels feel rough and harsh. Then the wet coffee is spread into a thin layer on cemented floors in the open air, sun and wind being utilized to evaporate the remaining moisture. This part of the work is often very tedious; firstly, because there is not always sufficient sun and wind for this purpose and, secondly, because the parchment shell which enclosed the kernel, as well as the kernel itself, is very difficult to dry. Therefore, a hot-house to dry coffee with heated air cannot be dispensed with. The necessity of a supplementary artificial drying apparatus imposes itself the more stringently because coffee cannot be stored before it is absolutely dry. Discoloration and deterioration are unavoidable when coffee is stored before being perfectly dry.

The next procedure is that the parchment be removed by hulling and fanning simultaneously. It may be remarked here that the native preparation does not include this treatment, as the natives simply pound their coffee with heavy poles in big troughs. After the hulling, the sifting and sorting take place in accordance with the requirements of the coffee trade. The sorting is done to size and color, and some sorts of coffee, such as Sumatra and Menado, are then stored and kept sometimes for one or several years. During this storing period the product must be from time to time turned over by means of rakes, but it must be borne in mind that by keeping the coffee in store the color fades and small boring insects often attack the product. However, storage improves the flavor and consequently increases the value.

THE COMMERCIAL POINT OF VIEW.

From what was said above it appears that planting coffee in Netherlands East India is a costly scheme. Not taking into consideration the purchase price of the land, the average cost of bringing 1 acre into bearing is estimated at $100.

The yield depends for coffee, more than for any other tropical product, on weather and temperature.

Robusta coffee guarantees a crop exceeding the yields of other coffees so far cultivated in Netherlands East India.

Notwithstanding its trade reputation as being of a lower grade, and consequently fetching lower prices than other coffees in the market, the greater security it affords the planter in view of the bigger crops predisposes this coffee, considering all circumstances, to be a desirable cultivation for Netherlands East India.—Extracts from a paper by BARON SALAK in the TEA AND COFFEE TRADE JOURNAL.

VEGETABLE PAINT.

In certain parts of Uruguay the farm buildings are a fine white colour, even during the wet season. To obtain this neat effect a whitewash is used, made from the sliced "leaves" of the Prickly Pear, which, when macerated in water for twenty-four hours, produce a solution of creamy consistence. To this lime is added and well mixed in. When the solution is applied to any surface, be it wood, brick, iron, or other material, a beautiful pearly white appearance is produced, which endures through rains and frosts for many years.

RICE.

RICE GROWING IN BRITISH GUIANA.

British Guiana, a few years ago, was a conspicuous example of a colony with only one important agricultural industry; in addition to sugar and its by-products there were no other exports, except a small amount of cacao, obtained by cultivation. To-day sugar easily maintains its premier position, but there is also an important rice industry yielding sufficient to supply the large local demand and to leave a considerable and increasing surplus for export. So promising is the industry that hopes are entertained that British Guiana, in the not distant future, may become "the granary of the West Indies." Before entering into any details regarding the change which has been effected in British Guiana it will be well to refer briefly to developments in other parts of the world.

Rice, the staple foodstuff of more people than any other cereal, is native to south eastern Asia. For many centuries the countries to which it is native and the adjacent regions maintained a monopoly of the cultivation; they are still far ahead of all competitors. Other countries, however, are steadily increasing their rice output, and some which at one time imported the grain now raise sufficient to leave a surplus for export.

Various causes have contributed to this result. In the United States rice was introduced some 250 years ago. For a long time Carolina and Georgia remained the chief producing regions, the crop being grown and harvested under conditions not differing essentially from those obtaining in Asia. The swampy lands forbade the use of labor-saving machinery and the crop could not be produced at as low a rate as where cheap tropical labor is available. In about 1880 prairie regions in Louisiana and Texas were opened up, and by extensive irrigation works land, normally dry, is artificially flooded so as to permit of growth of rice. By subsequent withdrawal of the water the crop is harvested under conditions permitting of the use of modern machinery. The economy thus effected, together with the introduction of improved varieties, revolutionised rice cultivation in the States, and Louisiana and Texas now produce 80 to 90 per cent. of the rice crop of the country, which in 1908 amounted to some 301,786 tons, or about 75 per cent. of the total consumption, whereas prior to 1880 the proportion was only about 60 per cent. of the then much smaller consumption. Rice production in the United States has much more than kept pace with the growth of the demand.

Rice was introduced into British Guiana from Georgia in 1853. It did well, and some of the crop was sent to England, where, as cleaned rice, it realised 30*s*. per cwt., or 5*s*. more than the ordinary Carolina rice at the time. A subsequent introduction appears to have been made from Carolina in 1865. An industry began to grow up and a company was formed, but owing to large crops in India, combined with a local scarcity of labour, the venture proved unremunerative.

The cultivation lingered on until, in 1902, a shortage of Indian rice, with a consequent rise in price, gave it an impetus, and the area under cultivation was increased.

A trustworthy indication of the material progress of the industry may be gathered from the trade returns. As recently as 1895-6 rice was imported to the extent of 22,000 tons, valued at £183,394. This has been largely dispensed with, and in addition to meeting the large local demands rice began to be exported in 1902-3, when about 500 tons, worth £60 left the colony; in 1908-9 the export was 3,115 tons, of the value of £59,037, and this year, the complete figures for which are naturally not yet available, the exports to date show a considerable increase on those for the corresponding period of last year. The rice exported goes chiefly to the British West Indian Islands and some to French and Dutch Guiana.

The general outlook for the industry is full of promise, although there is always the possibility that heavy crops from India may drive prices below the remunerative point. Last year the export was affected by the presence in the West Indian markets of cheap East Indian varieties.

The utilisation of by-products has not been neglected, and rice meal, and also the husks saturated with molasses, forming an excellent cattle food, are exported in considerable amounts.

British Guiana is at present the greatest rice-producing country in South America. Peru produces nearly as much, and the Argentine also has an extensive industry. In British Guiana, however, rice cultivation is making great strides, and there is every prospect that an important industry will be permanently established, and that within the next few years the colony may attain much greater importance as a source of rice both for itself and for the neighbouring countries; *especially if experiments in hand in cultivating and harvesting the crops by mechanical means should prove successful.* The quality of British Guiana rice, it should be noted, is very high. The choicest, the "Berbice Creole," appears to be excelled only by Carolina Golden Grain, the best of all rices, and if care is taken to maintain the standard and to meet the requirements of the market in the mode of preparation British Guiana rice may win a place for itself in the markets of Europe.—THE TIMES.

RICE PRODUCTION IN BRAZIL.

ALFRED L. M. GOTTSCHALK.
RIO DE JANEIRO.

The growing importance of the rice production of Brazil, and the fact that the country is rapidly learning to support itself in this important foodstuff, are shown by the gradual decrease through the years of Brazilian imports of rice. The more recent changes are indicated by the figures for 1913 and 1914, with the respective quantities and values for each of the countries from which Brazil imports rice. These figures, with the weights given in kilos of 2·2046 pounds each, are given in the accompanying table.

Countries of Origin	1913		1914	
	Quantity, Kilos	Value	Quantity, Kilos	Value
Germany	758,679	$76,183	202,880	$17,479
United States	10,375	1,268	2,798	325
United Kingdom	247,782	23,825	21,234	2,132
Netherlands	123,185	12,668	235,162	17,661
India	5,538,991	539,066	4,508,983	362,333
Other countries	1,098,349	91,106	1,563,976	119,469
Total	7,777,361	744,116	6,535,033	519,399

Changes during a period of five years are indicated by the quantities imported annually. In kilos the amounts were: In 1910, 17,320,437; 1911, 16,532,262; 1912, 10,226,254; 1913, 7,777,361; 1914, 6,535,033.

STATISTICS OF PRODUCTION IN TEN STATES.

Recent statistics of the rice production of the several States of Brazil are not available. The latest, for 1910, in liters of 0·9081 quarts each, are: Para, 200,000; Maranhao, 971,000; Parahyba, 1,950,000; Ceara, 2,730,000; Espirito Santos, 24,000; Rio de Janeiro, 11,323,000; San Paulo, 62,555,000; St. Catharina, 1,820,000; Rio Grande do Sul, 2,925,000; Minas, 28,463,000.

Later returns when received will undoubtedly show large gains in the Brazilian production of rice, the domestic article gradually displacing the imported product. This follows in line with a movement noticeable in certain parts of the country to diversify crops, and to make certain regions produce their own supplies of foodstuffs formerly imported from abroad.—TEA AND COFFEE TRADE JOURNAL.

RICE GROWING.

THE PHILIPPINE PLANTER for November last has been kindly sent to us by the Editor (MR. A. W. PRAUTCH) and entirely proves its claim as "a progressive agricultural journal." Though of modest "get up" the magazine is full of interesting information. Among other subjects discussed is that of rice growing by MR. FRANK PERRIN.

The writer points out the importance of the fact that the prime necessity for successful cultivation is the possibility of absolutely controlling the water supply and the flooding of the fields. While the rice plant thrives and grows to maturity with its roots and a part of its stalks immersed, it is as easily damaged by flood and ruined by drought as any other grain crop. The conditions are most favourable where water can be easily procured, where all danger of flood is minimised and where the water could be drained from the field at the proper time.

In the West where cultivation has reached a high level, the ground is prepared in exactly the same manner as for wheat or any other cereal before drilling; then follows the necessary irrigation; after which (when the crop has sufficiently matured) the lands are got dry enough to admit of harvesting machines being used.

American rice is said to be superior to that grown in the Orient, and there is reason for this since the American farmer employs the most scientific methods while the eastern cultivator has to make the best of natural conditions, which are not always favourable with his primitive ideas and appliances.

GREEN MANURING RICE.

G. C. SHERRARD.

A green manure is a crop grown on land and afterwards ploughed into the place where it has been grown, that is, it is buried in the soil, where it decays and provides food for the next crop grown there. There are many occasions when it may be advisable to apply such a manure, and it is of course usually more advantageous when the growth of the green manure crop does not stop the owner of the land from growing any other crop that he would usually take off the land.

It is not the purpose of this article to explain exactly why or how burying a lot of green plants in the land can benefit another crop grown on that land ; it is enough to say that plants feed on things that they take out of the soil just as much as men live on things that they eat, and that under certain circumstances plants growing in the ground can indirectly get a lot of nourishment from other plants that have rotted in the ground. I here wish to tell you some of the results that have been achieved in Bihar from giving a green manure to rice.

First of all, however, I will explain how this green manuring is done. It is very easy. As early in the rains as possible, that is to say usually about the time the rice seed is sown, the land to be green manured should be ploughed and cultivated and then sown with either san-hemp or *dhaincha*,* the amount to sow is 30 pukka seers per acre of san-hemp, and 15 seers of *dhaincha*. The cost of this cultivation and sowing is very light even if the cultivator is not able to use his own bullocks, which in most cases he would be able to do. Whichever crop is sown, it is left to grow until the time comes to puddle the land. Before puddling a *chowki* or wooden beam should be driven through the crop to break it down, and the land is then puddled in the ordinary way except that it is usually necessary to drive the plough round rather more times than in land which has not got a green manure crop in it. All the green manure should be mixed with, and buried in, the mud. The seedlings are then transplanted. It is better if a week elapses between the time when the green manure is ploughed in and the rice transplanted.

The following results are those obtained on farms in this Province by this treatment. Two plots of land were taken and treated in exactly the same way except that one was green manured and the other was not, that is to say, the same rice was transplanted at the same time on each plot, etc.

AT THE DUMRAON FARM IN NORTH SHAHABAD.

Year.	Kind of green manure ploughed in.	Weight of grain per acre from the green manured land.		Weight of grain per acre from the unmanured land.		Increase per acre due to the green manure.	
		Mds.	srs.	Mds.	srs.	Mds.	srs.
1908-09	San-hemp	29	0	22	20	6	20
1908-09	*Dhaincha*	25	0	22	20	2	20
1909-10	San-hemp	31	30	21	10	10	20
1909-10	*Dhaincha*	34	0	21	10	12	30
1910-11	San-hemp	26	5	20	0	6	5
1910-11	*Dhaincha*	36	10	20	0	16	10
1911-12	San-hemp	20	0	15	25	4	15
1911-12	*Dhaincha*	28	20	15	25	12	35
1912-13	San-hemp	14	10	9	25	4	25
1912-13	*Dhaincha*	13	30	9	25	4	5
1913-14	San-hemp	19	30	15	25	4	5
1913-14	*Dhaincha*	23	12	15	25	7	27

* *Sesbania aculeata.*

AT THE BANKIPUR FARM IN PATNA.

Year.	Kind of green manure ploughed in.	Weight of grain per acre from the green manured land.		Weight of grain per acre from the unmanured land.		Increase per acre due to the green manure.	
		Mds.	srs.	Mds.	srs.	Mds.	srs.
1910-11	*Dhaincha*	26	11	15	15	10	36
1910-11	San-hemp	27	30	17	20	10	10
1910-11	*Dhaincha*	26	33	17	20	9	13
1910-11	*Ditto*	26	1	16	10	9	31
1910-11	San-hemp	27	22	16	10	11	12
1910-11	*Dhaincha*	27	7	16	10	10	37
1911-12	*Ditto*	30	22	19	3	11	19
1911-12	San-hemp	31	7	21	1	10	6
1911-12	*Dhaincha*	30	7	21	1	9	6
1911-12	*Ditto*	34	35	20	10	11	25

AT THE CUTTACK FARM IN ORISSA.

Year.	Kind of green manure ploughed in.	Weight of grain per acre from the green manured land.		Weight of grain per acre from the unmanured land.		Increase per acre due to the green manure.	
		Mds.	srs.	Mds.	srs.	Mds.	srs.
1906-07	*Dhaincha.*	12	20	10	10	2	10
1907-08	do	29	0	22	20	6	20
1908-09	do	35	20	30	0	5	20
1909-10	do	26	0	19	0	7	0
1910-11	do	29	20	22	10	7	10
1911-12	do	31	0	28	30	2	10
1912-13	do	29	27	28	11	1	16
1913-14	do	22	12	17	27	3	25

From the above tables it can be seen that this practice of ploughing a green crop into the land before the rice is transplanted has actually resulted in a larger yield of rice. Some further notes on this subject will be given in the next issue of this journal.—AGRIC. JOURNAL, BIHAR & ORISSA.

TOBACCO.

TRANSPLANTING TOBACCO.

See that your seed-bed is well moistened before the plants are pulled, and that care is taken not to harm the rootlets, or, in fact, any part of the plant when removing it for planting out. HOWARD, in India, tells us: "When removing your plants use a pointed skewer, either of bamboo or iron, about the thickness of a lead pencil. This should be pushed into the seed-bed to a depth of about 3 in. at intervals of every 3 or 4 in. When about to remove the plants well water the bed, and leave it for about three hours whilst the water percolates through various holes and gets down to the roots, then apply the 'progger' and get to work." Having reminded you of this, we now come to that important stage in the life-history of the tobacco-plant, i.e., transplanting.

From reports to hand it seems that, although transplanting is still done by hand as a rule, machines, any rate in America, are used to a considerable extent, and, according to HARPER, tobacco can with their aid be set out in dry weather and a good stand obtained. The great thing to aim at throughout is to produce plants as uniform as possible in every way, i.e., in texture, growth, height of plant, size of leaf, and last, but not least, in rapidity of growth—plants that take a long time growing are no good as profit-makers. The growth of the plant, according to MR. and MRS. HOWARD, has to be completed in two months' time, viz., from the middle of October (that is in Behar), when the young plants are established, till the middle of December, when their growth is checked by the cold. Any late-set-out plants, which miss this period of growth, are always behind the rest and invariably give a diminished yield. Further, their presence renders the product un-uniform, so that the fields cannot be cut and cured at one time.

Lack of skill in raising and transplanting the seedlings goes a long way to discourage, if it does not directly cause lack of uniformity in the crops, and owing to this lower prices are given for the tobacco when the leaves come to market.

Referring to the suggestion that when moving or withdrawing the plants from the seed-beds, one should make a metal or wooden implement, first to loosen the earth round the plants, and then to push up the seedlings, KILLEBREW tells us much the same when he says: "The most careful hands are set to work to draw the plants from the beds. Carelessness and neglect at this stage are certain to tell seriously on the results of the crop. In removing the plants, wet the bed thoroughly unless this has just been done by a good rain, then take a common two-tined fork or a stick sharpened to a point at one end, run this gently down by suitably-sized plants and, first loosening them, then gently prise them up."

Leaving the nurseries with the young plants ready for removal, let us turn our attention to the field in which the plants are to be set out and where they will have to remain until removed to the curing barns. Here we cannot

pretend to coach up our readers as they need being coached if they wish to be successful. All we can say now is that the fields must always have an adequate, but never an excessive, supply of water, and it must always be up to the mark as regards plant foods, i.e., suitable and sufficient manuring. As regards the latter, the planter must remember that more care is necessary in the selection of the manures for tobacco than for any other crop, since everything you want in the leaf depends for their being upon what is taken up by the plant out of the soil. And as care must be taken to get the right formula for the manure, so is it equally necessary to get the right quantity of water; if there is no need to insure your fields against drought, all the better for you. It is, however, wonderful to note how many tobacco-producing centres are obliged to have some method for supplying water to the crop when Nature fails to do so. At the same time trouble is equally likely to come if a surplus quantity is supplied, for the excess makes the leaf darker and heavier and spoils it in the pipe or cigar. Irrigation is a great aid in getting a good "stand" of plants when the ground is dry at transplanting. When a new, up-to-date book is written on tobacco planting we hope the author will take us out into the fields and tell us how to break-up, plough, harrow, and generally prepare the ground for the final setting-out of the plants, discussing which make of plough is the most suitable, and whether there are any special ways of ploughing the fields according to the lay of the land and the variety to be raised.

KILLEBREW and MYRICH discuss the preparation of the land according to the variety of tobacco, but what they tell us only makes us want more. Discussing heavy shipping tobacco we learn that most of the cultivation, as one can well imagine, should be performed before the plants are set in the ground, and in order to do this the land, if a clayey loam, should be well and deeply broken in the autumn by a turning plough drawn by two or three horses or mules. The land should not be closely ploughed but left in ridges, the advantage of doing so being that a much larger surface is exposed to the weather. This particular advice referred to an area subject to frosts, but the soil in the Tropics equally benefits by being exposed. "If the depth of the furrow should be 8 in.," KILLEBREW goes on to say, "the ridge would probably be from 12 to 15 in. high, allowing a portion of the dirt to fall back in the furrow." In the States a second ploughing takes place, but then the furrows are only half as deep as with the first. Tobacco grown on uneven and hilly lands of course requires special culture and considerable skill, for the clean culture that tobacco requires is bound to make the land unproductive in the end. In Kentucky, when preparing the land for White Burley tobacco, two methods are employed, viz.: a plough with a "skimmer" just in front of the subsoiler to reverse a slice of the sod; whilst the other method is to turn the sod under with a two-horse plough to the depth of 8 in., and a revolving disc harrow is run over the land in April to cut the sod to pieces.

And so the tale goes on. "Tell me the soil that you have and I will tell you the tobacco that it will produce," the planting expert tells me, but they should, and probably do, add: "Tell me the soil that you have and the tobacco it will grow and I will tell you how to cultivate it and keep it up to concert pitch." In these notes, therefore, we cannot discuss the many ways

of cultivating the land according to the variety of crop to be grown, but plenty of ploughing, cultivating, and hoeing is necessary, as anyone who studies a book on tobacco culture can quickly realize.

In their pamphlet on "The Improvement of Tobacco Cultivation in Behar," MR and MRS. HOWARD tell us that "some form of furrow irrigation by which the plants can be watered without destroying the tilth is a great advantage when the rainfall has been insufficient. The main object of cultivation is to give the plant a loose soil into which the young rootlets can easily and quickly penetrate. If the tap-root is broken in transplanting, the plant tends to become surface rooted and develops a mass of fibrous roots. After the final preparation of the field (this is at Pusa) furrows about 18 in. wide and 4 in. deep are laid off at the proper distance, so that there will be a furrow between the alternate rows of tobacco, and these furrows, when irrigation is necessary, can be filled several times from a distributing channel which runs at right-angles to the rows." Drainage, the same as irrigation, must also be carefully arranged for, or else the land will become water-logged and stunt the growth of the plants whilst turning the leaves yellow. On this account, again quoting MR. and MRS. HOWARD, "the after-cultivation of the tobacco plant is of great importance, for unless the soil is frequently stirred the plants not only will not grow rapidly, but they also become yellow and unhealthy. After rain has fallen, if a surface crust has been formed, the ground should be stirred round the plants. As soon as the soil is thus given a new supply of air by this surface cultivation growth begins again and the plants take on, in a day or two, the dark green appearance characteristic of a thriving tobacco crop. This explains why it is important to pay so much attention to the cultivation of the soil with tobacco which, being a rapid grower, requires a large amount of air in the soil for the benefit of the roots;" for this reason also clean weeding is essential.—TROPICAL LIFE.

THE ORIGIN OF COAL.

The most recent investigations—those of JEFFREY (*Econ. Geol. IX.*, and also *Knowledge* October, 1915)—add considerably to our knowledge of the nature of coal. From these investigations, it appears that the more bituminous coals consist mainly of, and owe their properties to, spores of coal-measure plants. Improved methods of microscopic examination show that ordinary coal consists of alternate layers of shiny lignitoid material—woody remains—and of duller canneloid remains of flattened spores. It is wonderful indeed to reflect that the power developed in the steam-engine of to-day is derived from that stored in the minute spores of fern-like plants which grew ages ago. That these spores fell to the ground, were washed down in countless numbers by the rain, accumulated in lagoons, fell as a dust-like rain to the bottom, and underwent a sequence of slow changes, whereby they were transformed into coal. Undergoing yet further changes, and losing the last traces of organised structure, they doubtless yielded the mineral oils from which our stores of petrol are obtained.

SOILS AND MANURES.

THE SUPPLY OF NITRATES.

One of the minor misfortunes to the cause of the Allies, coming through no fault of their own, has been the landslide in the Panama Canal, which has interfered with the import of nitrate of soda from Chile by prolonging the time of the voyage. Nitrates are, of course, required in enormous quantities for explosives, but a very considerable amount of nitrate of soda—no less than 100,000 tons per annum—is used in agriculture for manurial purposes. No modern farmer would like to try to do without it; indeed, any increase in food production almost necessarily means an increase in nitrate consumption. Yet MR. ACKLAND recently stated in the House of Commons that the quantity now in this country, or on the way to it, was only about 30,000 tons.

As yet the situation is not serious. Farmers do not use nitrate of soda until spring-time; February or March would represent the earliest date when most people would apply it to their crops. Further, the Board of Agriculture has already made an arrangement whereby farmers can buy the sulphate of ammonia produced in this country, and formerly exported, at a price not much above the pre-war prices—£14 10*s*. per ton, instead of £12 10*s*. To this extent the situation is relieved, but, nevertheless, no one would care to see the supply of nitrate too much restricted.

There are two ways of dealing with the difficulty. One is to leave it alone, and trust that matters will somehow right themselves before February; the other is to arrange forthwith for a supply of artificial calcium nitrate. This substance was on the market as a fertiliser before the war; it has been tested on the large scale, and is known to give satisfactory field results; its defects have been studied, and a body of experience has been gained which would now prove very useful. But somehow it seems to have disappeared as a fertiliser since the war began. It ought not to prove impossible of manufacture, and in any case the situation ought not to be allowed to develop too seriously before steps are taken to cope with it.—NATURE.

THE COMPOSITION OF WOOD AND PLANT ASH.

R. A. BERRY.

In the autumn of last year, 1914, some ash analyses were made in the chemistry department of the West of Scotland Agricultural College. The object was to determine the amount of potash in the ash of certain forest and plant produce, with a view to the utilisation of the ash as a possible source of potash. Although several articles have since appeared in this JOURNAL* dealing with the same subject, the results obtained might still be of some interest.

* E. J. RUSSELL, JOUR. BD. AGRIC., Vol. xxi., No 8, November, 1914.
C T. GIMINGHAM, JOUR. BD. AGRIC., Vol. xxii., No. 2, May, 1915.
E. J. RUSSELL, JOUR. BD. AGRIC., Vol. xxii., No. 5, August, 1915.

The ashes, which were obtained by arrangement with the Forestry Department of the College, may be taken as being fairly representative, and they were produced and collected under conditions in operations in practice.

The percentage of potash soluble in (a) strong hydrochloric acid and in (b) water were determined; the results are given in the following table:—

Ash.	Potash (K_2O) percentage soluble in		Percentage of "Total Potash"* soluble in water.
	Acid	Water.	
Bracken	20·45	10·61	51·9
Spruce	11·94	8·23	68·9
Mixed forest produce	3·13	1·50	47·9
Hardwood, engine fire	10·44	6·77	64·8
Softwood, forest fire	11·79	6·53	55·4
Hardwood, largely oak trimmings ...	3·53	2·75	77·9
Flue dust from blast furnaces:			
No. 1	3·75	2·13	56·8
No. 2	3·93	2·64	67·2

Considered from the point of view of the total potash content, it is clear that four of the ashes could quite well be used as a potash manure in place of a low grade potash salt such as kainit, which contains 12·4 per cent. of potash. Indeed, on a valuation of the bracken ash on the basis of the potash soluble in strong acid, and taking the price per unit of potash previous to the war at 4s., the value of this ash would work out at about £4 per ton, whilst several of the other ashes would be worth about one half of this figure. Valued according to the current market price per unit of potash the price per ton would be considerably higher.

On the other hand, not much more than one half of the total potash is soluble in water, the soluble potash salt being mostly the carbonate of potash, so that it would appear questionable to value the ashes for manurial purposes on the basis of the total potash content only, whilst a valuation based upon the water soluble potash might give a low estimate of their true value.

Some of the ashes contain appreciable quantities of phosphates, which must be taken into account in judging the ashes for manurial purposes. The percentages of phosphates and other constituents are given in the following table:—

Ash	Phosphoric acid expressed as		Lime CaO	Magnesia MgO	Manganese oxide MnO
	P_2O_5	$Ca_3(PO_4)_2$			
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
Bracken	3·37	7·35	10·90	3·69	0·84
Spruce	7·01	15·30	28·20	2·90	1·35
Mixed forest produce ...	1·54	3·36	12·40	2·03	0·47
Hardwood, engine fire ...	5·02	10·95	44·70	4·71	2·23
Softwood, forest fire ...	5·23	11·41	25·20	3·80	2·14

* Total Potash=Potash soluble in strong hydrochloric acid.

The phosphates present are practically all insoluble in water and are mostly in the form of calcium and magnesium phosphates. Their value for manurial purposes should be much the same as the value of the phosphates in steamed bone flour. Their presence in such relatively large amounts adds, of course, considerably to the value of the ash. The other constituents given in the table are, perhaps, of small interest only.

When the material is properly burnt, the ashes are bulky and of a light friable and powdery nature, generally grey in colour. If necessary they should be passed through a sieve of 3/16-in. mesh, to get rid of stones and unburnt material. They must be protected from rain, otherwise the soluble potash salts might all be dissolved out and lost. They are strongly alkaline and, when mixed with ammonia salts, liberate the ammonia freely, more especially if the ashes are damp; otherwise, with the exception of ammonia salts, ashes form a suitable medium for mixing with most manures. They must be stored in a dry place.

As the value of the ashes is judged by the amount of potash and phosphates which they contain, the following table may be useful for the purpose of comparison :—

Ash.	Total potash K_2O	Percentage of total potash soluble in water.	Phosphate of lime $Ca_3(PO_4)_2$
	Per cent.	Per cent.	Per cent.
Bracken	20·45	51·9	7·35
Spruce	11·94	68·9	15·30
Mixed forest produce	3·13	47·9	3·36
Hardwood, engine fire	10·44	64·8	10·95
Softwood, forest fire	11·79	55·4	11·41
Hardwood, largely oak trimmings ...	3·53	7[illegible]·9	2·40
Flue dust from blast furnaces:			
No. 1	3·75	56·8	Not ascertained
No. 2	3·93	67·2	

Apart from the chemical content, the economic importance of the ashes at the present time will depend upon the quantities available. The results of some recent investigations* given below will throw some light on this point.

1. From the "lop and top," undergrowth, weed growth, and litter in any average type of woodland, about ½ ton of ash is produced per acre.

2. From portable saw mills and foreign timber mills, where wood constitutes the fuel, about ¼ cwt. of ash per day is obtained as a by-product.

3. Ten acres of fully-stocked bracken land is found to produce 1 ton of ash, the quantity being dependent upon the density of the crop.—JOURNAL OF THE BOARD OF AGRICULTURE.

* See Leaflet No. 25, Board of Agriculture for Scotland.

FIXATION OF NITROGEN FROM THE ATMOSPHERE.

The most recent research on the subject, that of DR. E. MAMELI and PROFESSOR G. POLLACCI, shows that not only the Leguminosæ, but many other flowering plants are able to make use of atmospheric nitrogen. Among flowering plants for which they claim this power are Cucurbita pepo, Acer negundo, Polygonum fagopyrum, and they also ascribe it to such "Water-Ferns" as Azolla caroliniana and Salvinia natants. FRANK long ago maintained the view that the power of assimilation of free nitrogen belongs to all green plants, and this view receives support from these recent researches.—

GARDENERS' CHRONICLE.

ORGANIC MATTER AS A CULTURE MEDIUM FOR AZOTOBACTER.

F. L. MOCKERIDGE.

In order to discover how far *Azotobacter* is capable of utilizing the wide range of organic compounds which occur in soil, cultures of the organism were inoculated into series of media made up of various organic substances and mineral salts. The organic substances in question included humates, polysaccharides, sugars, alcohols, the calcium salts of organic acids, esters, glucosides and benzine derivatives.

In the case of the humates, growth was only obtained when the organic matter was supplied as ammonium humate and no nitrogen was fixed. The availability of the glucosides was restricted somewhat by the products of their decomposition and the benzine derivatives proved totally unable to provide a source of energy for *Azotobacter*. The presence of either of these two latter classes of compounds, however, never inhibited growth on manitol-agar plates. The carbohydrates tested showed themselves in general to be readily available sources of food for *Azotobacter*. The returns of nitrogen fixed for the expenditure of food material varied considerably and the rule seemed to be that the longer the time taken to use completely a unit mass of the nutrient, the less nitrogen was fixed upon that medium.

Considering the wide range of compounds which *Azotobacter* proved itself capable of assimilating, it is evident that any ordinary soil must contain abundant food material for the growth of the organism.—BULL. INT. INST. OF AGRICULTURE.

FOREST SOILS AND NITROGEN.

The usual practice is to classify soils crudely according to their chemical and physical composition, but we can often get a better idea of their constitution and requirements by considering them in relation to the kind of crops they bear. In the tropics this is particularly so where a wide range of soils occurs between the two extremes of desert and dense forest. Speaking generally, it is not the soil particles so much as the heat and the rainfall as well as the aspect, including physical conformations, that determine the most

important features of a soil's fertility, because these factors decide what plants can grow there. If the rainfall is heavy, the natural covering will be forest, and as a result of vegetable decay the underlying soil will be rich in humus, and will exhibit certain well-marked bacterial characteristics. This soil is the natural medium of growth for such trees as cacao and rubber, and becomes ultimately what we have come to call an orchard soil. On the other hand, soils which are more exposed to wind and sun, and which receive a lighter rainfall, are inhabited naturally by a hardier type of vegetation, and these are the soils which are ultimately brought under the plough. Such soils as these frequently exhibit greater alkalinity and greater extremes of texture between 'heaviness' and 'lightness', and in the matter of colour, than orchard soils, while the bacterial activity is also different in many respects.

It is our present object to consider what takes place in an orchard soil that makes it different from an arable soil, especially in respect of nitrogen supply.

The form in which cacao and other orchard crops obtain their nitrogen from the soil has been the subject of speculation for some time. Knowing that the supplies of free mineral bases, such as lime, are deficient in such soils, it has been suggested that ammonia formed in the process of ammonification may function as a base for the neutralization of nitric acid formed during the later stages of nitrification. It is well to bear in mind, however, that nitrification may not be active in all orchard soils and that, moreover, nitrifying organisms will not tolerate free ammonia. Where nitric acid is absent it may be supposed that the ammonia would combine with other acid radicles like carbon dioxide or some organic acids, the nitrogen in this way finding an entrance into the roots of plants in a less concentrated form than ammonium nitrate.

In an examination of cacao soils in Dominica it was found that at the end of several years' trials, the amount of nitrogen was greater than at the outset, and this is attributed to nitrification. A bacterial test of the different soils clearly demonstrated the existence of nitrogen fixing organisms, and it has been concluded that under the conditions of the plot experiments referred to, considerable accretions of nitrogen may occur as the result of the action of free nitrogen-fixing bacteria of the Azotobacter type, and that the amount of nitrogen fixed may be very greatly increased in the presence of an ample supply of organic matter.

These conclusions are very important because nitrogen fixation is not supposed to play an active part in such soils, at any rate under temperate conditions. An interesting note has appeared on nitrogen fixation in Danish forest soils. *Azotobacter chroococcum* is only occasionally present in these soils, but in some localities where there is much calcium carbonate, two other species of Azotobacter were found present. The causes of the absence of the principal species from forest soils were thought to be due to lack of calcium carbonate, to too low a temperature, and to an excess of humic matter.

That temperature is an important factor has been shown recently in India, and it may explain the apparent divergence between the cases of Azotobacter and the orchard and forest soils of Dominica and Denmark. In general, 30°C was found to be the optimum temperature for maximum activity in India, and it would appear therefore that warmth is an important factor.

In the Dominica investigations the temperature of the plots was studied, and the observations never showed a reading higher than 25°C.

It has to be remembered that though they have many features in common, the conditions of an orchard soil and a forest soil are not absolutely parallel. So far no bacterial examination of true forest soils has been made in the West Indies, and we do not know whether Azotobacter occurs in them or not. If these nitrogen-fixing organisms are absent, it would be interesting to know how the supply of nitrogen is maintained. The suggestion arises as to whether mycorhiza may not play an important part. The fungi of mycorhiza live either on or in the roots of plants growing in humus soils, and are very widely distributed. The relation between the fungus and root is generally symbiotic, that is to say, useful to both organisms, at least in the case of those which live within the root, the fungus assisting in the collection of nitrogen and in the elaboration of albuminoid substances in return for carbohydrates manufactured by the green plant There are instances where the union occurs between a fungus and a non-chlorophyllous plant, as in the case of Neottia. Here we apparently have an example of a higher plant parasitic on a fungus, and it is difficult to see what advantage is derived by the fungus. In general it is more than likely that fungi of mycorhiza are of greatest value to the higher plants on account of their capacity for manufacturing higher nitrogenous compounds from soluble humus which they absorb from the soil. It should be pointed out, as an interesting morphological feature of the roots of trees bearing the external fungi, that root hairs are entirely absent, a circumstance which shows that the fungus functions as an organ of absorption.

The extent to which mycorhiza plays an active part in the nutrition of tropical forest plants is not definitely known, and it would be interesting if this question were given specific attention in the West Indies. Further, it may be the subject of enquiry whether many of our economic plants like rubber and cacao can, under certain soil conditions, make use of mycorhiza, especially where the soil is typically acid.

It would appear desirable for the planter to realize that the presence of lime, the importance of which in the soil has been so strongly emphasized, does not seem always necessary for orchard or forest fertility. Acidity does not appear injurious, and may even be beneficial, as is thought to be the case with rubber in the Federated Malay States. Of course with arable soils, effects other than neutralization have to be considered. Here lime is important because of its physical as well as its chemical properties rendering the soil more amenable to cultivation. In the case of tropical soils we know that the addition of lime both increases nitrification and nitrogen fixation. Recently in the Philippines it has been demonstrated that the former process is increased by more than half by the application of 6 tons of lime to the acre, while all observers have called attention to the importance of lime the latter process. The fact remains that orchard and forest plants, and even arable plants, can, in some circumstances, thrive in the absence of lime, and it would be interesting to know exactly to what extent bacteria are responsible for their supply of nitrogen.—AGRICULTURAL NEWS.

RESEARCHES ON THE ABSORPTION OF AMMONIA BY THE SOIL.

After a critical discussion of the different theories regarding the absorption of gases and liquids, the writer gives an account of his own experiments for the purpose of determining the absorptive capacity of different soils. Research hitherto has dealt exclusively with the various constituents of the soil and the results are of no general value to practical agriculture.

As a substance capable of absorption the writer used ammonia gas which has the treble advantage of being easily absorbed, of existing in the air, and of constituting a source of nitrogen for the soil. The absorption of the gas was determined by two different methods, various samples of soil being taken, some from Germany, some from other countries. The capacity of the soil for retaining hygroscopic moisture was estimated by the method of MITSCHERLICH.

The experiments have shown that the absorption values do not allow of any better conclusions being drawn, for practical agriculture than those obtained from physical and chemical analyses of the soil. In German soils the absorption value was parallel to the hygroscopic value. In the case of "red soil" (1) *terra rossa*, the hygroscopic capacity was more regular than in German soils. This is probably due to the fact that the hygroscopic capacity of the *terra rossa* is not always comparable with that of the German soils.

The isotherms constructed on the values of absorption of ammonia gas by the soil closely resemble those constructed on the absorption values of the same gas by charcoal. The greater part of the gas was absorbed in a few minutes, but a stationary condition was only reached at the end of some hours. In the case of soil still containing hygroscopic water, the absorption value was much higher than in that of dry soil, but did not reach the sum of the absorption values for dry soil and water. Part of the ammonia gas absorbed was strongly retained by the soil, even if the latter were subsequently exposed for several weeks to the open air. It was impossible to obtain any parallelism between the absorption of an ammoniacal solution and that of ammonia gas, although, according to the writer some relation does exist between them.

The charcoal from lime trees has a great capacity for absorbing ammonia gas, but possesses less power of absorbing this gas when dissolved in water.

The writer concludes from his experiments that the absorption of ammonia gas varies considerably on account of the complex nature of the soil. It is therefore very difficult to formulate an absorption theory applicable to all kinds of soil. However, it seems that the theory of FREUNDLICH according to which absorption is a condensation process occurring at the surface of the soil particles, is the most probable.—BULL. INT. INST. OF AGRIC.

(1) The "Roterde" or term *terra rossa*, came in some cases from Istria, in others from Brazil, East Africa, etc.

TOP-DRESSING.

The top-dressing of wheat in winter with a nitrogenous manure is not a common proceeding, and therefore the leaflet issued by the Board of Agriculture, suggesting an application this month of sulphate of ammonia, has created some little surprise. It should be noted that the counsel based on the result of Rothamsted experiments and that the advice is sufficiently qualified to warrant the assumption that the writer was aware of the pitfalls associated with such a proceeding. The wheat crop is one of the least exacting in its wants, but it is exceedingly responsive to timely attention in what may seem small matters. It is especially sensitive to judicious winter and spring management, a peculiarity that makes farmers chary about using forcing manures at this time of year. To the inexperienced a strong winter growth might appear to be the main thing to aim at: in practice, however, excessive winter luxuriance is scrupulously to be avoided. As many growers have greater difficulty in moderating growth in an average winter than in inducing it the diffidence about using a quick-acting fertilizer will be understood. It is not asserted that sulphate of ammonia should never be given in December; but it is claimed that cases in which the practice can be adopted with good results are few, and that great care is needed to select those where it would be profitable.

TILLERING PROCESS.

The objection to excessive winter development is well-founded and the reason is simple. The tillering or stooling faculty of this and other cereals plays a very important part in determining production. The skilful grower endeavours to utilize this habit of growth to the fullest extent. Some might even go so far as to say that his success depends upon the way he contrives to foster it. Any way, it is an accepted fact, that a plant that tillers badly will never yield a heavy return of grain or straw. The tillering process takes place in late spring or early summer. The weather influences its activity, but the development of the plant is also of importance. A crop that is too forward in growth does not branch out so freely as one moderately advanced, and hence the concern with which the farmer regards wheat that has become "winter proud." So serious a view does he take of undue luxuriance in winter that in spite of the risk he runs he will delay drilling until November, when he might have got the seed in in good condition early in October, and if other devices fail he will run his sheep over it in early spring to eat it down to the desired state. The vital point is to keep the plant moving steadily in winter and to topdress at a time that will make the spurt synchronize with the stooling operation. If this course be pursued the crop will be thick on the ground, as well as long in straw and ear, and the prospect of a prolific yield greatly improved as compared with what would result from winter luxuriance that would restrict the spreading habit in spring.

A nitrogenous manure to be effective must be given at the right time. The observant husbandman has little difficulty in fixing upon the correct moment. He watches the progress of the plant and when it appears to be in trouble he gives the needed stimulus. Sulphate of ammonia is not quite so rapid in its action as its imported rival, and therefore can be applied a little earlier, but few care to risk topdressing wheat with this manure before the second half of March, when, if the crop shows signs of flagging, 1 cwt. to the acre is extremely helpful.—THE TIMES.

MANURING EXPERIMENTS WITH CITRUS SEEDLINGS.

B. F. FLOYD.

In order to obtain more accurate information on the value of various manures for citrus trees, pot culture experiments were carried out with pomelo seedlings grown in sand. Measurements of the length and breadth of the stem and length and breadth of the leaves were made during the season.

This preliminary report deals with the effect of ammonia and phosphoric acid from varying sources. The best growth was obtained with a combination of dried blood and acid phosphate. The addition of lime appeared to retard growth. Sulphate of ammonia and acid phosphate gave the poorest growth of any of the various combinations and showed an improvement when lime was added.

Basic slag was a better source of phosphate than superphosphate for use with ammonium sulphate and nitrate of potash but only second best with dried blood. Nitrate of soda and nitrate of potash were equal in their effects of growth.—BULL. INT. INST. OF AGRIC.

RAIN MAKING.

The artificial production of rain is to be put to the test of practice in Australia. According to THE ELECTRICIAN the New South Wales Government will finance the experiments, which will be carried out by Mr. J. G. BALSILLIE, who for years has been conducting research in this connection and who has patented his device. It is based on the following lines. In the laboratory he finds that if a room be filled with steam, the discharge of high tension direct current electricity together with the simultaneous discharge from a powerful Röntgen ray tube causes the whole of the air to be cleared of steam in 1½ seconds, the floor of the room being covered with large drops.

A captive balloon coated with metallic paint at a height of 6,000 to 7,000 feet will be used to discharge electricity into the atmosphere and this it is hoped will cause sufficient ionisation to provide nuclei upon which the moisture of the clouds may condense. Mr. BALSILLIE believes that a number of these stations would draw all the moisture from the clouds and would also cause the cessation of natural thunderstorms.—BULL. INT. INST. OF AGRIC.

ENTOMOLOGY.

THE CONTROL OF INSECT PESTS.

P. B. RICHARDS.

Fumigation by carbon-bisulphide is accomplished by injecting into or pouring round the objects requiring treatment the requisite quantity of liquid carbon-bisulphide.

Properties.—Carbon-bisulphide is an oily colourless liquid which possesses a pleasant smell when pure, but the commercial product usually smells like rotten eggs and is yellow on account of contained impurities. It is very volatile, vapourising with extreme rapidity in the open at ordinary temperatures. It should be stored in stoppered casks or jars—not corked bottles—and to prevent loss by evaporation a small quantity of water may be run in. As the liquid is heavier than water and is only very slightly soluble, the water forms a protective layer over the top of the carbon-bisulphide.

As a liquid it is highly inflammable, while the vapour when mixed with air explodes violently on ignition. The ignition point is very low. No fire of any sort, or even any hot body the temperature of which is above the boiling point of water, 212°F., should therefore be allowed in or near a store of carbon-bisulphide or the place where fumigation is in progress. In treating a building supplied with electricity, the current should be cut off before fumigation commences. Carbon-bisulphide should be stored in a cool place, and should not be exposed to the sun.

Liquid carbon-bisulphide in considerable quantity is poisonous to man. Inhalation of the gas produces violent headache and nausea and is to be avoided, but is not dangerous in the same degree as hydrocyanic acid gas. The main danger in its use is from fire.

Insects subjected to the action of carbon-bisulphide vapour are at first anæsthetised and later asphyxiated. The action is slow, taking many hours to ensure death unless the atmosphere is very heavily charged with the vapour.

Carbon-bisulphide vapour is readily diffused, getting thoroughly into all holes and crevices. It is therefore, notwithstanding its lower toxicity, a better fumigant than hydrocyanic acid gas for treating seed, cereals, pulses, and other foodstuffs, and close packed manufactured articles. The vapour is heavier than air, so should be applied from above downwards.

Uses.—(a) Seeds and foodstuffs stored for any length of time, especially in hot climates, are very susceptible to insect attack, which may be so serious as to render the stock valueless either for food or for planting. To mention a few which occur in Malaya, stored rice is attacked by Rice Weevil, *Calandra oryzæ*, and by the caterpillars of a small grey Tineid moth, *Sitotroga cerealella*. Wheat, flour, grain, and similar foodstuffs are often heavily infested with small Pyralid moths of the genus *Ephestia*, the caterpillars of which may be found in matted galleries of silk running throughout the food. Flour and biscuits also are attacked by a small red Tenebrionid beetle, *Tribolium sp.*,

which spoils provisions by giving them a very repulsive taste. Dried peas and beans are attacked by several species of Bruchid beetles, sometimes to the total destruction of the stock. Annoyance is often caused to smokers by the cheroot beetle, *Lasioderma serricorne*, which infests stored tobacco, the larvæ feeding here and there throughout the body of the cheroot, and the adult making small round holes in the wrapper for emergence. The loss to the tobacco manufacturer from the beetles boring through bales of cigar wrappers of good quality, thus rendering them unfit for use, is often enormous.

These are but a few cases which might be cited of insect attack upon stored vegetable matter. Owing to the smallness of the stocks in any one place these pests have not compelled the attention here which has had to be given them in the larger grain producing countries, where enormous stores of grain are held for considerable periods. Nevertheless, the average loss in Malaya must reach a considerable sum. It is estimated that in India the Rice Weevil alone "at a moderate estimate may be said to destroy five per cent. of all stored grain which is kept for more than a couple of months after harvest." The methods applied on a large scale for big stocks of grain elsewhere are equally applicable for warehouses, kedais, and private stocks here, and if practised would amply repay the outlay in labour and materials.

There is no known method for treating stored vegetable produce in general which renders it permanently immune to insect attack if exposed, and which does not at the same time unfit it for food or for germination. The only sure preventive is to store in insect proof bins, jars, or tins after getting rid of any infection. It is to get rid of the insects harboured at the moment that fumigation with carbon-bisulphide is employed. Re-infection may take place quickly if the fumigated material is not at once stored in an insect-proof place. Should this not be feasible, repeated fumigations may be necessary in order to prevent the pests from reaching enormously destructive proportions.

For the treatment of grain one pound of carbon-bisulphide is allowed to each hundred bushels. In treating large quantities, some of the liquid is introduced through a pipe into the middle of the heap and the remainder poured on top. To keep the pipe clear when pushing it into the heap, a stick is loosely fitted into the pipe and withdrawn leaving the pipe in position. For smaller quantities, the material to be treated is placed in a barrel or bin that can be made fairly airtight—the less leakage, of course, the better—and the requisite quantity of carbon-bisulphide either placed in shallow dishes on the top of the material or, if grain, poured directly on to the material. The cover is at once put on, and left for twenty-four hours, after which the bin is opened and allowed to air, and the material after airing at once stored in insect proof receptacles. If storing is delayed for a day re-infection may have taken place.

The quantity of carbon-bisulphide required for fumigating small quantities of material may be taken as one ounce to fifty gantangs if the chamber is full of grain, or the same quantity to fifteen cubic feet of space if other materials are being treated. For small vessels or boxes, allow one teaspoonful to each cubic foot of space.

A useful form of fumigating chamber consists of an airtight wooden box the cover of which is provided with a flange which fits into a gutter all round the outside of the box. The gutter is filled with water, and when the lid is put on the flange dips into the water, making an airtight fitting. This type of chamber is not available for hydrocyanic acid gas fumigation as this gas is soluble in water.

In the absence of an airtight box, heavy cloths thrown over the top assist in retaining the fumes.

Soil Fumigation.—Many injurious animals such as cockchafer grubs, wireworms, root aphids and eelworms, living below the surface of the ground and feeding upon the roots of plants, are controlled by injecting carbon-bisulphide into the soil close to the affected plant. Care should be taken not to allow the fluid carbon-bisulphide to come into contact with the roots, or the plant may be badly injured. No trouble should however arise from contact of the roots with carbon-bisulphide vapour, except perhaps a temporary set-back which is more than compensated for by the subsequent increase in vigour of the plant.

Carbon-bisulphide is best injected into the soil by means of a special injecting pump which regulates the dose and the depth at which it is applied. In the absence of such apparatus, a hole to the required depth may be made with a rod, the dose of liquid poured in, and the hole at once stopped with earth.

The individual doses vary from a quarter of an ounce to four ounces, and the depth at which applied may be from six to twenty-four inches according to the nature of the soil and the conditions of attack. No fixed rules can be laid down to meet all cases, and planters who contemplate using carbon-bisulphide for soil injection are recommended first to communicate with the Agricultural Department.

Treatment of large boring beetles in fruit trees, rubber trees, etc.—Clean up the mouth of the burrow with a sharp knife, or with a small auger. Inject about a teaspoonful of carbon-bisulphide into the hole and plug up the hole with a tight fitting cork or with clay. An ordinary oiling can makes an effective injector.*

SULPHUR DIOXIDE.

Sulphur dioxide is prepared by burning sulphur in air. For purposes of fumigation the sulphur is placed in a shallow open vessel which in turn, as a precaution against fire, is placed in a larger vessel containing sand and earth. Two pounds of sulphur are buried for each thousand cubic feet of air space.

Properties.—Sulphur dioxide is a colourless gas, with a characteristic suffocating smell which produces a sensation of choking. It is not inflammable. The gas is soluble in water in combination with which it pours sulphurous acid.

Sulphur dioxide gas is poisonous to insects but it is also directly harmful to vegetation. Leaves are "scorched" by a weak mixture of the gas in air, while at greater strengths buds and young shoots are killed. The fumes also destroy the germinating power of seeds and have considerable bleaching effect on fabrics.

Use.—It is obvious from a consideration of the above properties that sulphur dioxide is not applicable to plant fumigation. Its major use is for killing bedbugs and such like vermin in empty rooms and for this purpose it is excellent, being cheap, effective, and easy to employ. The sulphur is ignited and the room at once closed. The fumes should be allowed to act for 24 hours.

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* BAINBRIGGE FLETCHER recommends for boring beetles the injection of a mixture of two parts chloroform and one part creosote. This mixture has the advantage over carbon bisulphide of acting as a preservative to the wood.

On the other hand it is more expensive. See "Some South Indian Insects.", p. 133.

CARBON DIOXIDE.

Carbon dioxide can be readily prepared by treating limestone or marble with hydrocyanic acid. The gas is, however, universally used for the preparation of mineral waters for which purpose it is put up in liquid form in steel bottles, and it would probably be more convenient to obtain these than to prepare the gas on a small scale for oneself.

Properties.—Carbon dioxide is a heavy colourless gas, which is incapable of supporting combustion or respiration. Asphyxiation results from breathing the pure gas, while an atmosphere containing upwards of 10 per cent. of carbon dioxide produces an effect on animals similar to narcotic poisoning. Plants and particularly seeds are able to withstand for a considerable period an excess of carbon dioxide which is quickly fatal to insects. Sufficient work has not yet been done on the subject to warrant any broad generalisations, but there can be no doubt of the utility of the gas in the treatment of delicate plants and in the disinfection and storing of valuable seed. It is, however, in connection with valuable dried products such as spices and tobacco that carbon dioxide is likeliest to appeal to Eastern cultivators. Hydrocyanic acid gas and carbon bisulphide cannot be unreservedly recommended for the fumigation of such products on account of the danger of impairing their quality. No such result will be feared if carbon dioxide is used, provided that the material for treatment is dry. In particular should this method be applied to all cigars, cigar wrappers, cigarettes and other valuable tobacco before storing and again before packing as a precaution against the attack of the cheroot beetle.

NICOTINE TOBACCO.

Fumigation with tobacco is only of service in the treatment of plant lice and such small insects attacking greenhouse plants and small pot plants. The fumes are obtained by burning tobacco stems and dust, or by evaporating aqueous solutions of nicotine in a shallow pine. The plants to be fumigated may be placed in a fairly airtight box and the fumes led in from the generator through the bottom of the box by means of a pipe.

SUN DRYING.

One should apologize for the inclusion of such a foreign subject in a chapter on Fumigants, but as the treatment of stored grain is one of the most important matters considered under that heading this is perhaps the best moment to discuss the use of the sun as an insecticide.

All insects require a certain amount of moisture in their surroundings and their food to enable them to live. This percentage varies according to the habit of the insect. Less is required by grain feeding insects than by most others, but even they cannot live in thoroughly dried grain. The object of sun drying is to reduce the moisture content of the attacked food beyond the minimum necessary to support the life of the particular pest.

Colandra oryzæ, the rice weevil, which yearly destroys large quantities of stored rice in Malaya is one of the pests which is amenable to this method of treatment. BAINBRIGGE FLETCHER, writing of this pest in India, says:—"It has been found by experiment that a certain minimum (about 8 per cent.) of moisture in their surroundings is necessary to the successful existence and breeding of these weevils, so that if grain can be well dried in the sun to reduce its moisture content as much as possible and then stored in insect

proof receptacles in a dry place it will be as secure from attack as is possible under practical conditions. In districts where paddy is stored in jars there should be little difficulty in having the grain sun dried before storage and then fastening up the jars so as to exclude weevils; for jars, not in use, an earthenware cap, luted on with clay, might be used, and those in daily use could be covered simply with a fine cloth tied round the neck of the jar. Care should of course be taken that the jars are thoroughly cleaned out and free from weevil or old infected grain before killing them afresh, and also that all fastenings are sufficiently tight to be weevil proof."

Silotroga cerealella, a small moth which is another important pest of stored rice, the pulse beetles which destroy stored peas and beans, and other small insects of similar habit, may be kept in check by sun drying. It is *par excellence* the method for kedai-keepers and raoits who have comparatively small quantities of such material to handle. Any dry place will serve to spread out the grain, but flat adobe or cement roofs would be ideal. Large stocks, however, cannot be conveniently handled, and when such require treatment, carbon bisulphide should be employed.—F. M. S. AGRICULTURAL BULLETIN.

MARKET FOR TEA.

After a long period of depression, the market for tea has at length touched a level that suggests that it has found its basis. At the top point reached in the summer common kinds stood at 11½*d.* to 11¾*d.* per lb., and very little was to be got under. At such prices demand was very keen, because there was so little to go round; now the reverse is the case, there being an abundance, while trade is marked by decided languor. Common of useful quality can be bought at 7*d.* to 7¼*d*, while inferior is to be had in plenty at 6*d.* to 6½*d.* When abnormally high prices ruled there was every inducement for planters to pluck freely. This has been the case, and quality has consequently been sacrificed to quantity. The market is overdone with a heavy weight of Indian tea of inferior and plain description, and has caused general reluctance on the part of buyers to operate. More recently there has been more enquiry, prices being very moderate; also there is the usual stocking going on in connection with the Christmas trade. The increase in the duty has told upon consumption and hit the distributor, as more capital is locked up by the extra duty, thus leading to a certain stringency in the financial position. Deliveries from the docks are very slow owing to the shortage of labour, and this matter promises to get worse instead of better. Merchants at the lower prices have been more disposed to offer rather reduced quantities recently of Indian. There is a big yield in India this season, the outturn for November being particularly heavy. This has also had an adverse effect upon the market, but the ratio of progress between actual crop and export figures is widely divergent, because shipments from Northern India have been much retarded owing to the scarcity of tonnage, and this shortage is likely to become accentuated. As the outcome of this state of affairs, it is apparent that the selling of Indian tea will be more than usually prolonged.—LONDON COMMERCIAL RECORD.

DRUGS.

THE CULTIVATION OF CINCHONA IN JAVA.

DR. J. VAN BREDA DE HAAN.

During the period from 1829 to 1837, attention was frequently drawn to the probability of a future shortage of cinchona bark from South America, where the tree occurs wild. Several botanists who were acquainted with the climatic conditions of Java suggested that the Dutch Government should take steps to introduce the cinchona into the island. In 1851 the first serious attempt at transporting the tree was made: WEDDEL had succeeded in collecting some seeds of *Cinchona calisaya* in Bolivia; some of them had reached Paris and plants had been raised from them in the hot-houses of the Jardin des Plantes. The Botanical Gardens of Leyden obtained possession of one of these cinchonas in exchange for some other tropical specimens, and this was sent to Java in 1851; it arrived there in a deplorable condition, but fortunately two cuttings made by TEYSMANN took root and one of them was the origin of a tree which grew satisfactorily for 16 years.

But these first attempts were not considered sufficient, and in 1852 the Government sent DR. HASSKARL to South America to collect seeds and live plants of the best species of the genus and bring them to Java. He got some thousands of seeds and about 60 plants; owing to some mischance, the latter were lost, but the seeds reached Holland in good condition. After despatching other consignments of seeds, HASSKARL succeeded in embarking in August 1854, with 21 cases of live plants and a large quantity of seeds, on a Dutch man-of-war which was sent to Callao to meet him. In the middle of December, he arrived in Java with his precious cargo; 75 plants out of the 500 had survived the difficulties of transport; these were planted at an altitude of 5,000 feet at Tjibodas, where the two cuttings of *Cinchona calisaya* from Paris were already established. All the cinchona trees now cultivated in Java under the name *Cinchona calisaya javanica* are descended from these cuttings. Through the Dutch consul at La Paz in Bolivia were obtained the seeds from which have been raised the specimens of *Cinchona calisaya* Schuhkraft grown in Java.

What, however, contributed more than all these introductions to the development of cinchona cultivation in Java was the purchase of a number of seeds sent from London in 1865 by GEORGE LEDGER. The latter had obtained the seeds from his brother, CHARLES, who was travelling in Peru and Bolivia in order to buy cinchona bark. From these seeds collected by CHARLES LEDGER were raised about 20,000 plants, which subsequently produced bark superior in quality to that of all the others.

Further introductions, in the succeeding years, gave rise to a quantity of other cinchonas of different varieties and species; of these some twenty are cultivated in Java, but often the external differences between them are so small that it is necessary to determine them by chemical analysis of the bark.

The most common species and varieties in Java at the present time are *Cinchona ledgeriana*, a variety of *Cinchona calisaya*, and a hybrid, *C. ledgeriana* x *C. succirubra* : these produce nearly all the bark used for making salts of quinine.

For the production of bark used for pharmaceutical preparations and cinchona wines, *C. succirubra* and *C. robusta* (which is a hybrid between *C. officinalis* and *C. succirubra*) are grown. *C. robusta* is less rich in quinine, but contains in its bark a larger amount of tannin than the other varieties of hybrids, and at the same time produces other alkaloids, such as cinchonidine, quinidine and cinchonine.

The efforts of the Dutch Government have not been limited to merely introducing cinchona seeds into Java, but have also extended to the improvement and spread of cinchona-growing by demonstrations and trials carried out in the Government plantations established for the purpose. By means of botanical and chemical studies pursued for the most part in the laboratories devoted to this work and situated in the centre of the Government plantations, precise information has been obtained on the distribution of the various alkaloids in the different species of *Cinchona* suitable for cultivation in Java. It is found that for quinine production *C. ledgeriana* should be preferred while the barks of *C. succirubra* and *C. robusta* contain larger amounts of cinchonidine. Some alkaloids of less importance, such as quinidine, are especially found in the bark of *C. calisaya javanica* ; *C. micrantha* contains chiefly cinchonidine.

The alkaloids occur in the bark of the trunk, branches and roots. In the leaves and flowers a very small amount of cinchonine is found. The exterior part of the cortex is always the richest.

At two years of age, a cinchona tree attains its maximum quinine content; afterwards the amount of alkaloid decreases a little, until the tree is 12 years old. After this age, there is scarcely any change. As the bark of a five-year-old tree is of small dimensions, the maximum production per tree is only attained after the age of 12.

The quinine content of the Bolivian cinchona introduced by HASSKARL is estimated at about 2 per cent. The first tree obtained from these seeds only produced 4 per cent. after six years' growth. By continued care and with increasing knowledge of the improvements possible, a bark with 11 per cent. of quinine has been obtained, and the average quinine content for the last few years for all Java was about 6 per cent. (in 1913, 6·12 per cent.)

This improvement is the result of continued selection and the care taken in improving the plantations by using for seed, cuttings or grafting, trees whose alkaloid content had been ascertained by analyses. This method was carried out very conscientiously, especially in the State plantations, while the improvement of private plantations was assisted by the propagation of the best varieties and the sale of these improved cinchonas.

CULTIVATION.

The land most suited to cinchona-growing in Java is between 1,250 and 2,000 m. (4,000 and 6,500 ft.) above sea level. *C. robusta* grows well at the latter height, but a greater altitude would expose the plantations to damage from night frosts. Volcanic soils of recent origin give the best results, provided they are damp enough. Periodic drought hinders vigorous development.

The soils in the south-west of Preanger, near Bandong, are the only ones presenting the necessary conditions for satisfactory cinchona cultivation. Frequently plantations have been tried elsewhere, but the results have almost always been mediocre and unremunerative. In the other parts of Java and Sumatra there are only small and unimportant plantations.

As soils really suitable to cinchona growing are only to be found in the mountainous parts of Java, the exploitation of a plantation offers peculiar difficulties.

In establishing a plantation, choice should by preference be made of well wooded land on a slight slope, gving on clearing a soil rich in organic matter of good quality and permitting of adequate drainage. After the trees are felled, the ground is divided into terraces, these being well levelled to prevent washing away of the rich humus soil.

The cinchona seeds are sown in special nurseries well sheltered from the sun, which the germinating seedlings cannot bear. The seeds are extremely small; one pound of *C. succirubra* seed contains about 4 million, and a pound of the seed of *C. ledgeriana* about 1½ million. The greatest precaution is necessary to maintain sufficient humidity when the seeds have just germinated. After about a month the seedlings are up and must be gradually accustomed to the light. Six months after germination, the plants are pricked out and are gradually exposed more and more to the light. At the end of a year, transplanting is often effected, either in order to thin out the nursery beds, or to promote the growth of young plants intended for grafting. After 1½ or 2 years the cinchonas are sufficiently developed and accustomed to the sun to allow of their being finally planted out.

In using seed, even of known origin, there is no absolute certainty of finding the characters of the parent plant reproduced in its descendants. Propagation by seed can therefore not be resorted to if it is necessary to be sure of the characters of the resulting plants. In such cases, recourse is had to propagation by slips of grafting, and by these means plantations consisting entirely of very rich cinchonas can be obtained.

As *C. succirubra* produces the most vigorous trees in Java, it is often used as a stock for *C. ledgeriana*, which is richer in quinine. Since, however, it has been found that the stock exerts some influence on the alkaloid content of the grafted *C. ledgeriana*, attempts are being made to substitute for *C. succirubra* another variety offering still more guarantee for the maintenance of the high alkaloid content. Most of the plantations of *C. ledgeriana* are grafted in this manner. Raising from cuttings requires more care and does not give such satisfactory results.

The trees are planted out at distances of 3 to 5 ft. in holes 12 inches deep. The necessary cultivation work consists in hoeing to prevent the growth of weeds. Sometimes a leguminous cover-crop is taken or castor-oil cake is applied as a manure. On sloping ground, trenches are dug to collect the soil washed down by heavy rains.

After three years, the trees usually become too thick and it is necessary to begin cutting out the lowest branches. Some years later, a certain number of the trees must be removed so as to allow the others to develop normally. In the place of diseased trees, or in gaps due to other causes,

new nursery trees are planted. A ten-year-old plantation thus consists of trees of very different ages and the plantation can be progressively reconstituted and maintained for 25 to 30 years by fresh planting and the felling of unsatisfactory trees.

HOW BARK IS OBTAINED.

Various methods of obtaining the bark have been tried in Java ; the best and most commonly practised consists in cutting down the trees to 20 inches from the ground; the stumps and roots are then got up by making a circular trench round them; in this way the bark of the roots is not lost. In the case of *C. ledgeriana* and all the cinchonas used in the manufacture of alkaloids the bark is taken off in strips with a knife ; sometimes the bark is so adherent that a wooden mallet must be used to hammer it. The bark of *C. succirubra* is collected with more care in order to obtain rolled pieces about a yard long, called "pipes" or "tubes," the value of which depends upon the length and evenness. The bark intended for pharmaceutical purposes is exposed to the sun to dry slowly, so that the strips roll up well. The bark to be employed for the manufacture of salts of quinine, etc.. is dried in "Siroccos," in which the temperature is kept at about 100° C. A higher temperature would reduce the alkaloid content. In drying, the bark loses an average of 50 to 75 per cent. of its weight.

The yield of a nine-year tree of *C. succirubra* may be estimated at about 21 lb. of dry bark, containing 6 per cent. of alkaloids. In the Government plantations, which are admirably managed, the crop of dry bark is reckoned at 125 lb. per acre after the fifth year. This production rises in the succeeding years till it reaches 300 lb. about the eighth year, and then remains at 370 lb. per acre until the fifteenth or twentieth year. Then the whole plantation is usually cut down and renewed, or else the land is left fallow for some years before being replanted.

For exportation to Europe, the bark of *C. ledgeriana* or other species intended for the manufacture of quinine salts is pounded and packed in bales of 200 lb. The bark to be devoted to pharmaceutical purposes requires more careful treatment ; it is well packed in cases, sorted according to its origin into trunk, branch and root bark respectively. The price of this bark is determined chiefly by its external appearance. while that of the other kinds of bark is estimated from their alkaloid content, and from the analysis of a sample taken on their arrival in Europe.

Amongst the insects that attack cinchona plantations the most formidable is *Helopeltis antonii* Sign. ; it attacks the leaves, which roll up, turn black and fall. It appears that dense plantations have least to fear from its ravages. *Corticium javanicum* Zimm., a fungus attacking the bark, is especially found when it is very damp. Other fungi attack chiefly the branches and trunks, *Olpidium* being the commonest of them. In the nurseries, if the watering is not carefully done, the young plants fall victims to a fungus described as a species of *Pythium*. Fortunately, so far, the injury caused by insects and fungi has not been of great importance ; nevertheless the Dutch Government has appointed to its plantations a botanist to study the diseases of cinchona.

We will conclude this account by giving some figures showing the great development attained by cinchona-growing in Java in a very short period of

time. In 1879 the exports did not amount to more than 60 bales of bark. In 1889 they had already reached 6½ million lb.; the maximum, 20,370,000 lb. was reached in 1910. The fear of over-production and consequent fall in price decreased the quantity exported, which was :

In 1911	...	19,190,000 lb.	In 1913	...	20,900,000 lb.
In 1912	...	19,210,000 lb.	In 1914	...	15,315,000 lb.

In 1913, a contract was made between the planters and the manufacturers with a view to limiting production and maintaining a maximum price; the effects of this arrangement were already to be seen in the decreased exports of 1914.

The price of the unit of bark, 1 oz., which was 3·81 cents* in 1912, rose to 4·42 cents in 1913 and 6·20 cents in 1914, the latter being a very remunerative price assuring good returns to the present planters.

In 1914, there were in the Dutch Indies 114 plantations belonging to private individuals, 84 of these near Bandong in the West of Java; their total area was 34,030 acres. The Government plantations occupy about 2,570 acres.

While the greater part of the bark is sent to Europe and sold on the Amsterdam and London markets, a certain quantity is sold to a sulphate of quinine factory at Bandong, which is especially trying to monopolise the markets of the Far East. Some of its products are sold for local consumption in the Indies, but most of them are exported. The output was.

1910	...	3,851 cases	1912	...	3,225 cases
1911	...	5,597 cases	1913	...	2,258 cases
1914	...	1,978 cases			

This account of the cultivation of cinchona in Java, although necessarily rather brief, will at least give some idea of the importance to which this industry has attained in the Dutch East Indies, and show that not only suitable climatic conditions and good soil are necessary, but also the careful attention of a provident Government.—BULL. INT. INST. OF AGRIC.

THE BORNEAN CAMPHOR TREE.
(DRYOBALANOPS AROMATICA.)

P. VAN ZON.

In Sumatra, *Dryobalanops aromatica* Gaert. is found in virgin forests consisting of mixed stands sometimes extending over 50 acres. Measurements of Bornean camphor on a trial plot of ⅝ of an acre gave the following results :—

Average height	...	40 metres 130 ft.)
Average diameter	...	97 cm. (38 in).
Form factor	...	0·5

The timber is very hard, of a dark red colour, and has a strong odour of turpentine.

"Oil of camphor" is obtained by boring the trunks of trees 20 or more years of age, while camphor itself is found in lumps in crevices and cavities inside the wood.—BULL. INT. INST. OF AGRIC.

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* The Dutch cent = 1/5 of a penny or 2/5 of the American cent.

SCHOOL OF TROPICAL AGRICULTURE.

The School of Tropical Agriculture was opened at Peradeniya on January 15, the Hon'ble Sir Anton Bertram, Attorney-General of Ceylon, presiding at the opening ceremony which was attended by a large number of people from all parts of Ceylon and representative of all professions and industries in the Island.

OPENING OF THE SCHOOL.

SOME OF THE SPEECHES.

SIR ANTON BERTRAM in the course of his speech remarked :—I say to you young men who are joining this school as students, in adopting that study you have done well. In no other place could a School of this description have been founded more appropriately than the country to which you belong, the Island of Ceylon. (Applause.) Ceylon is, and always must be, and I trust always will be, pre-eminently a place for Agriculture. It is in the paddy fields, the coconut groves, and the plantations of Ceylon that the life of the country really exists and not in the streets of Colombo. In all Agricultural countries there grows up a great excrescence in the great cities—in Australia, Melbourne city, and in Ceylon, Colombo. But if we want to see the home of the people of these countries it is to be found in the fields, where Agriculture is carried on. And, therefore, I say it is most appropriate that this new idea, which I believe to be a fruitful idea, is being inaugurated. We shortly shall have an Agricultural College in Peradeniya, but as MR. LYNE pointed out, this is the first step. What we are founding to-day is a gate of that institution through which the youth of Ceylon will pass to enjoy its benefits. MR. HARWARD spoke about the relation of the Agricultural Department to the Department of Education, and said that in his official career he looked forward to this school to promote its growth. I think, however, it will do more than that. I am sure you will concur it is a recognition of the fact that our ideas of education in the past have been too restricted ; that popular education in all countries like this has been altogether too much on literary lines. Education in the past has been too much in the hands of persons of scholastic impulses, and has not been what we are trying to make it nowadays, and what MR. HARWARD told us he was striving to do, his department being in touch with the life of the people and its realities. I repeat, this Agricultural School is a recognition of that fact. It means that in the elementary schools of the country something is going to be done to make the education carried on there more consonant with the lives of the children there. As I looked at the group of these students taken in MR. LYNE's garden a few minutes ago I saw in the midst of it six Vernacular students to whom MR. HARWARD has alluded, clad, not in the picturesque khaki costume of this school, but in the costume of their own villages ; and I saw in those six

Photos by H. F. Macmillan.

MONUMENT ROAD,
Showing the Gardner Memorial in the distance.

View through the Fernery
from the Main Central Drive.

ROYAL BOTANIC GARDENS, PERADENIYA.

[See article *The Home of the School of Tropical Agriculture*, Page 4, "Tropical Agriculturist" for Jan. 1916.]

students the beginning of what I trust will be a great development in education in Ceylon. MR. HARWARD told us that these six students were pioneers, and that in time to come all the elementary pupil teachers under the department in Ceylon will go through this training in practical Agriculture, and when they come to teach the children in school it will not be merely book-learning but something more in harmony with the occupations of the pupils when they grow up in later life. I trust also it will mean that, not only in elementary schools, but in secondary schools there will be a recognition of the practical study of Agriculture, the opening up of the secrets of the earth, the exploration by those engaged in the pursuit of Agriculture of those secrets which will open to them new revelations in scientific learning, in the scientific world, which will make them look upon their pursuits with a practical eye and bring to their studies the new principles they find in their scientific pursuits. I hope those principles will be recognised not only in the elementary but secondary schools as well. And when we have an Agricultural College in Peradeniya as a department of the University College we shall then have through the length and breadth of Ceylon an educational element vital to the life of Ceylon. (Applause.) I understand the school we are founding to-day will have three branches. It will have first a Vernacular side where those who are going to be village school teachers will be trained practically in the scientific principles of those pursuits which are more appropriate to the villagers. We shall have further in the school many young men who are destined to become themselves proprietors. They are themselves owners of land and are going to learn agriculture, to put in practice in their estates and fields what they acquire there. There is a third element—those who are going to make Agriculture their career, who are going to earn their living on estates, and who are qualifying themselves in this school for employment in the future work of their lives. I wish them all a successful career, and I think it augurs well for their future from what I can see.—At the conclusion SIR ANTON said:—We have heard what MR. HEW KENNEDY, Chairman of the Planters' Association, and MR. H. L. DE MEL, Secretary of the Low-country Products' Association, said. I trust there will be many others, representatives of other Associations, and others who look forward to obtaining for their staffs men of trained intelligence from this institution; and that I trust is the direction in which the school is going to be worked. I trust that this school, begun on a comparatively modest scale to-day, though at present it must be spoken of as an experiment, yet it is an experiment with a certainty of success, for this reason that it has been received so universally as being the right thing in the right place.

MR. H. L. DE MEL said:—On the foundation well and truly laid to-day may there rise a superstructure worthy of the founders and worthy of the builders. The founders have done their duty and will cheerfully impart to you the knowledge they possess and which they have acquired during their researches amidst the magnificent Botanic and Experiment Gardens. On you the students there rests a very serious responsibility and duty. Let me congratulate you in the first place for having decided on this profession and for coming in as pioneer students to-day, to receive an education in agriculture for the express purpose of developing and improving the same for the general prosperity. "What is the best education?" was the question put to PLATO many centuries ago. "It is," he replied, "that which gives to the body and

to the soul all the beauty and all the perfection of which they are capable." This statement is true to-day I venture to say as it was then. Is not the study of the possibilities of mother earth and her treasures itself beautiful? You have now decided to put your hands to the plough. Continue then to plod steadily along and not turn back. Give your mind, and your body to perform its best work. May I suggest for your consideration two little thoughts throughout your career. "Bring out the best that is in you." You will, when you go through this course, obtain your certificates and go out to work, be looked upon as agricultural missionaries. Then you must be "by example and precept" a model to your countrymen and therefore you must use the best talents you possess in the truest way. The second point is "to make the best of your environment." The beautiful tropical and sub-tropical array of wealth in this historical Botanical Gardens with such a salubrious climate as to even make it temperate cannot but fail to inspire you with a study of the sciences with which it is allied. Then think of the opportunity you will have of daily meeting the scientific staff of the Department of Agriculture who will be your lecturers, the mingling of thought with thought will stimulate you to action. The avenues of your mind will be open and alert. You will learn to appreciate all the beauties of Nature and the power behind. Having reminded you of some part of your duty it is only right that the public and others interested in local agriculture and prosperity of this island should act reciprocally and give you every encouragement and assurance. You have just heard the Chairman of the Planters' Association, a veritable stronghold of energy, indomitable perseverance and devotion to duty, give you assurance of the British Planters' support. What would the mountain slopes of the Kandyan Provinces be if not for the British Planter? The enormous concessions he has obtained for the people of this country, in obtaining scientific aid in the cultivation of various plantations and the facilities of transport will ever remain a monument to his foresight, energy and perseverance and it is only right that I should bear testimony to that fact on a day like this and ask you to imbibe these excellent traits of the British Planter in Ceylon. You will naturally expect more support of the people of this country. I regret that the chairman of the L.P.A.C. was not able to be present here to give you his assurance but you need no reminding of the fact that the L.P.A.C. have for years been urging the desirability of imparting education to students at Peradeniya. I am sure the Association will continue to give you all the support and encouragement you desire and deserve. As evidence of the practical sympathy towards agriculture as a profession, may I instance to you that the only son of one of our past Chairmen has already qualified in agriculture, obtained a degree and diploma, and taken to the land. The only other chairman who has a son old enough to decide a profession has decided to send him to this School of Agriculture next year. He is not old enough to join this year. I refer to the second son of DR. GERALD DE SARAM. Some of you students will no doubt have to cultivate the acres that have been a goodly heritage from your parents but there are others who will have to place their talents, training and energy at the disposal of the Estate proprietor. For myself I think I can give the assurance that the outlook is extremely hopeful. I can also be responsible for securing billets for at least 10 students. I know a number of other proprietors who will be able to do similarly. In conclusion I wish to thank Government, and the Director of Agriculture for

this important equipment mounted to-day and started to foster the planting industry of Ceylon, I wish the school all success and prosperity. The thought betokens the wish that the school will ripen into a college and the college in course of time will be affiliated to the University of Ceylon and that your successors will be hereafter able to obtain not only a diploma but a degree recognised throughout the world. (Loud applause.)

APPRECIATION FROM *TROPICAL LIFE.*

Hearty congratulations are due to Ceylon and its energetic Director of Agriculture on the way in which they have gone steadily ahead, in spite of the War and the consequent scarcity of money, to secure an agricultural college for Ceylon. Month by month, since we encountered MR. LYNE in Leadenhall Street the day after war was declared, he must have been steadily pegging away until to-day. If they have not yet secured *the* actual college, they have, speaking figuratively, at least laid the egg known as the School of Tropical Agriculture, from which the full-grown and vigorous bird, i.e., the College, will be hatched later on to be developed and expanded as opportunity and funds permit.

From time to time we have seen odd paragraphs in the Ceylon press that led us to hope the idea had not been entirely dropped on account of the War, but we did not realize the progress that had been made until a copy of the prospectus of the School of Tropical Agriculture, at Peradeniya, came to hand. We were agreeably surprised at receiving it.

By it we see that the Director of Agriculture is the Principal, and MR. DRIEBERG, Superintendent of Low-Country Products, the Vice-Principal, whilst the staff of the Department of Agriculture will constitute the lecturing and demonstration staff on the School.

Those who know Ceylon will be interested to hear that the School is situated close to Peradeniya Gardens, on the main road from Colombo to Kandy, ten minutes from the new Peradeniya station. Peradeniya Gardens are nearly a hundred years old, and as they cover an area of 150 acres and contain almost every economic product of importance, the student surely can wish for nothing better as a centre of education, both in the open as well as indoors, as the library has 6,000 volumes, and the herbarium 22,000 floral specimens, whilst other sections have over 10,000 specimens of economic importance.

Such a spot must also be ideal for English students, for Peradeniya is situated some 1,600 or 1,700 ft. up, and enjoys a mean temperature of 75° F. The nights are said to be always cool, and even in the hottest months the days are not too oppressive for study. Candidates for admission must be at least 17 years of age, and have attained a certain standard of education. The fees, payable in advance, are Rs. 30 per month for board and tuition, or Rs. 7·50 for tuition only. At present only a limited number of boarders can be accommodated. Work begins with the school muster at 6-20 a.m., and lights must be out by 10 p.m. Breakfast is at 11 a.m. and dinner at 7 p.m. There is no regular work for Saturdays, but independent investigations and expeditions are expected to be carried out. The course of instruction

includes: the soil, manures and manuring, the plant chemistry, the crops (a wide range, i.e., over seventy in all), pests, diseases, agricultural engineering, stock-raising, co-operation. Demonstrations will be given of how to plant, prune, graft, transplant, fell trees, and many other most necessary things, whilst under the head of planting everything necessary to learn in connection with each of the leading crops will be included; amongst them we note demonstrations in dynamiting for planting, for sub-soiling, blasting rocks and stumps, etc.

We wish the new enterprise every success, and trust that the warmth necessary (i.e., plenty of hard cash) to hatch out this splendid egg will soon be available so that Ceylon, at least, will be able to boast of a fine, full-grown, game College of Tropical Agriculture in its midst, crowing with all its might to draw students to its portals, and challenging Barbados and Trinidad in the West to do likewise, and then sit up to see which of the two birds or colleges is the best.

COCONUT BUTTER.

According to the United States consul at Carlsbad (Austria), most of the coconut butter manufactured in Bohemia is made of Cochin or Indian copra, which is received in large wooden tuns. The dried copra is sliced, and the fat is extracted by oil presses—quite a simple process. This raw oil contains soap fats and does not have a pleasant odor. It is placed in large tanks, and the first step in the refining process is the addition of powdered chalk, which absorbs the soap fats and settles to the bottom of the tank. The oil on the surface is pumped into another tank, passing through four or five filters as the second step in the refining process. It is then forced into a tank heated by steam pipes to about 270 to 318 degrees F. This process continues until the oil is clear as crystal and begins to bubble. It is then pumped into an automatic weighing apparatus and run into the moulds, where it is allowed to cool, the tablets or cubes are removed to the packing table. Part of the oil is run into various sized tubes and is also placed on the market in this form. The soap fats, combined with the chalk, are treated with sulphuric acid, which dissolves the chalk, leaving the fats floating on the surface of the solution. These are drawn off into tubes and are sold to manufacturers of soap. The trimmings of the copra slices are made into a powder, which commands a good price as fodder for cattle and pigs. The coconut fat is white, but when manufactured into butter is colored to resemble oleomargarine. Sesame oil is added to make the product more pliant. Coconut butter keeps well either raw or refined, and does not spoil for months, even in warm weather. It is claimed that ordinary consumers cannot detect the difference between this butter and oleomargarine. Six or seven years ago the output of coconut butter in Austria was about 40 tons a day. It is now approximately 300 tons. The price has increased from £3 15*s* to £5 8*s* 6*d* for 200 lb. The factories claim that they cannot keep up with the demand. The market is controlled practically by two firms—one in Vienna, the other in Aussig.—QUEENSLAND AGRIC. JOURNAL.

GENERAL.

SUDAN DURA.

There are four varieties, white, yellow, close grained and five months, being the easiest way to describe them from their Arabic names. The first three take four months from sowing to harvest, the latter five months.

Uses.—Dura is used for three purposes; flour for bread, green fodder, and grain food for cattle and horses.

Soil.—It should be sown in dry, well drained soil; it dislikes clay and sodden soils.

Sowing.—It can either be sown broadcast in prepared soil and afterwards harrowed in, at the rate of 10 pounds per acre; or it can be sown in shallow, one-inch-deep mamotie holes, one foot apart either way; 3 or 4 seeds in each hole. The holes then should be covered up with the foot and pressed down.

The seed should be soaked in water for one or two days till it shows signs of sprouting when it should be immediately sown.

The best time for sowing is when there is a period ahead of at least 2½ months rain after which there must be a certainty of dry sunny weather in which to harvest. If the crop ripens in the monsoon it will all become mouldy and half will be totally lost. Thus in the Central Province it should be sown early in November, so that it will flower in January and be harvested in March.

Cultivation.—The young plants should be thinned out to two plants in each clump when they are three weeks old, and kept clean weeded. The plants can be transplanted to any vacant places at this period provided there is plenty of rain. Hilling is beneficial but not absolutely necessary, save in the five months' Dura, which owing to its height is apt to be blown over by high winds and requires some support at the roots.

Harvesting.—When the heads are beginning to ripen and the seed is set, the lower leaves can be cut off from the stalk and fed to cattle, who eagerly devour it. Young leaves and shoots must on no account be fed to cattle, as it makes them ill. When the heads are ripening, the birds must be kept away by boys beating tins, as birds are very fond of the sweet soft seeds and will do much damage unless scared away.

When the heads are quite ripe they may be cut off close, conveyed to the threshing floor and allowed to dry in the sun before being threshed by cattle or by hand. The stalks must be pulled up and when dry burnt on the field.

Storing.—Care must be taken in storing the grain, as weevil are extremely fond of it and will cause great damage. If kept in sacks the stock must be examined every few weeks and if there is a sign of weevil it must be spread in the sun and plantain leaves spread near by. The weevil will seek the shade under the leaves where they can easily be collected and destroyed.

The best way to store it and that which is employed all over Africa is to build a mud construction like that employed in Ceylon villages for storing paddy (bissa). It must be raised from the ground on stakes supporting a platform of woven split sticks or cane. On this is erected upright canes either round or square and the whole plastered with mud and a final coating of cow dung.

An upward slanting hole should be made at the bottom with a wooden plug so that the weekly or daily dole of grain can be easily obtained without taking off the top and thus letting in damp or chance insects. As soon as the grain is threshed and thoroughly dry the construction should be filled up and a mud lid put on and sealed up with mud. The whole should have a cadjan or straw shelter from the rain. These grain stores will last for many years when once made and will keep the grain sweet, dry and free from insects for any length of period.

Consumption.—The grain is easily ground to a fine flour by ordinary native methods. In the Soudan it is daily ground on stones with a little water. The thick paste is then diluted with water to a thin paste and round, thin pancakes of bread are made on an iron plate over a fire. But it makes very good ordinary baked bread, without the use of yeast. It is very strengthening and sweet and not heating as is maize flour, and is very easily digested.

Cattle, horses, sheep, goats and poultry eat it with avidity and it will keep them in splendid condition.

Pests.—The Dura is attacked by an aphis or green-fly blight, but this will not do much damage, save in causing some of the leaves to turn black and render them unfit for fodder.

THE FIVE MONTHS' VARIETY.

This must of course be sown a month earlier. It is much taller than the other varieties and yields abundant green fodder and very big heads of large grain. But it naturally takes much more out of the soil than the others.

D. S. CORLETT.

ENDEMISM AND EVOLUTION.

The phanerogamic flora of the tropical island of Ceylon is very well known, and therefore affords data almost unequalled for statistical investigations and comparisons. Ceylon has engaged the attention of botanists from BURMANN (1737) and LINNÆUS (1747), through successive Directors of the Botanic Gardens down to DR. J. C. WILLIS, who continues his studies in the paper the title of which is given below.* Incidentally, it may be mentioned that Ceylon is about half the size of England, with mountains rising to an altitude of about 8,000 feet, and the latest statistics of the phanerogamic flora are: 2,809 species belonging to 1,027 genera and 149 families. DR. WILLIS's discussion of the endemic or peculiar element is highly interesting; though he starts on the erroneous assumption that Ceylon "contains an immense endemic flora, which enables it to rank with many oceanic islands: even the Sandwich Islands have not so many." He himself places the total number of endemic species at 809, which works out to 28·8 per cent., and, it may be added, only 23 genera are peculiar to the island. The percentage of endemic species in the flora of India is approximately sixty, in that of Central America seventy, and in that of the Sandwich Islands upwards of eighty. The highest degree of endemism, excluding small insular floras, such as that of St. Helena, obtains in West Australia, where it approaches eighty-five per cent. It is true that the flora of Ceylon comprises a larger number of endemic species of flowering plants than the Sandwich Islands; but it must not be forgotten that the total number of species in the former is four times that in the latter. However, these proportions do not affect the author's arguments in relation to endemism and evolution. His main point is that the

* "The Endemic Flora of Ceylon, with reference to Geographical Distribution and Evolution in General," by J. C. WILLIS, M.A., Sc.D., PHILOSOPHICAL TRANSACTIONS OF THE ROYAL SOCIETY OF LONDON. Series B, Vol. ccvi., pp. 307—342. 1915.

endemic species are, on the whole, much rarer than those of wider distribution, and that this fact is apparently destructive of the theory of natural selection and adaptation. For purposes of comparison DR. WILLIS groups the species under three heads, namely, endemic to Ceylon, common to Ceylon and Peninsular India, and those of wider distribution. Then, in relation to commonness, he follows TRIMEN in classifying each group under six degrees of rarity, beginning with "very common" and ending with "very rare." The results are exceedingly interesting and suggestive, and we reproduce his opening tabular view of the number of species in each group and class :—

	Endemic in Ceylon.	Restricted to Ceylon and Peninsular India.	Of wider distribution.
Very common	19	45	221
Common	90	118	462
Rather common	139	103	313
Rather rare	136	84	209
Rare	192	64	159
Very rare	233	78	144
	809	492	1,508

DR. WILLIS's deduction from this and other statistical data is that the endemic element has not developed "in any kind of advantageous response to local conditions, as must have occurred did natural selection obtain." The table shows that the endemic species increase in numbers from "very common" to "very rare," more than a quarter coming under the latter category, whereas those of wider distribution increase in numbers in the inverse direction. Degree of commonness WILLIS regards as the criterion of age. Thus the endemic element in the flora would be the youngest of the three series. The subject of evolution and distribution is so complex that we will only suggest that the converse might afford an equally probable explanation of the present conditions. Many endemic types now exist only in very small numbers. Coleus elongatus is given as an example of one that "must have evolved on the summit of Ritigala, where it exists as about a dozen individuals, and cannot ever have been much more numerous." We agree with the author that natural selection has not played an important part in the present distribution, and the term "survival of the fittest" is not a happy one.

The present vegetation of New Zealand offers a striking example of the changes effected by a foreign element. Upwards of 600 species of foreign flowering plants are now more or less completely naturalised in New Zealand, and competing with the native plants for existence. In some localities introduced plants have completely ousted the native vegetation. At least 75 per cent. of the native species of flowering plants and ferns are peculiar, and they comprise every type of vegetation, from the lowliest herb to the loftiest tree. Many are common throughout the islands in suitable altitudes. Numerous others have hitherto been collected in only one locality and may be classed as rare though future explorations may reveal a wider distribution of some of these. Now it is well known that the presence in New Zealand of many plants of wide distribution is of comparatively recent date; yet in many localities they are rapidly replacing the endemic plants. The late THOMAS KIRK was a keen observer and recorder of biological phenomena in New Zealand, and he emphasises the fact that such robust native plants as Phormium tenax, Cyperus ustulatus, Aciphylla

squarrosa and Pteris esculenta are displaced by European grasses and Clover. This is probably in part due to augmented vitality and fertility in "fresh soil." The endemic element of the New Zealand flora presents some very curious features in its composition, including, possibly, many of the oldest species, as well as the youngest, and some of the rarest as well as some of the commonest species; many belonging to genera of world-wide range; many to endemic or exclusively southern genera.—GARDENERS' CHRONICLE.

THE SAHARA DESERT.

FRANK R. CANA.

The size of the Sahara is indeed hardly realised. It covers approximately 3,500,000 square miles and is not much inferior in area to the continent of Europe. Though sand extends over probably 700,000 square miles, rocky plateaux and not sand-dunes are the chief characteristics of the desert. If a generalisation be attempted, the Sahara may be described as a great tableland scored by the beds of dried-up rivers, diversified by mountains and depressions, and fringed by a deep belt of sand west, north and east. Southward there is generally an intermediate zone between "the desert and the sown." The higher plateau and the mountain ranges occupy a central position and extend across the Sahara north-west to south-east. This elevated region is sometimes spoken of as the bridge connecting the Mediterranean lands with Central Africa, the means by which early man spanned the desert. It is hardly a continuous bridge and there is scant evidence of its use as a means of communication in historic times. It had by then probably served its purpose.

POSSIBILITIES OF LAND.

Regarded from the point of view of the contribution it may make to the world's wealth the Sahara does not seem a promising field. Yet it possesses one thing for which there is a great and apparently increasing market—dates. There are many millions of date-palms in the Sahara: millions more might be grown, and the Sahara dates are unequalled in quality. The difficulty is in getting them to market, and such railways as that recently opened to Tuggurt give the needed facilities. Information given by COMMANDANT GODEFROY—who both surveyed and built the Tuggurt line—with regard to the production of Rhir oases may be given as typical of the work carried out by France in the Algerian Sahara generally. In 1856 the Rhir had 200 wells and 339,000 date palms. In 1914 there were over 800 wells and nearly 1,500,000 palms Since the French occupation the production of dates had nearly quadrupled and was in 1914 some 30,000 tons. This was accomplished before the railway gave the people of Rhir the chance of putting their dates on the market. This year it was anticipated that 8,000 to 10,000 tons of dates, worth about £16 a ton, would be exported from Rhir, and with the coming of the railway the area of plantation can be very largely increased. COMMANDANT GODEFROY estimates that the Rhir can produce for exportation dates worth nearly £500,000 yearly. Already some French colonists have acquired palm groves. This example of what can be done in one oasis must serve to indicate what is being done in many others. When all the oases in the Moroccan, Algerian, and Tunisian oases are brought to full productivity and given easy means of access to the North African ports, the date industry should attain proportions as large as any demands made upon it. More distant oases can also be made more flourishing and thus able to support a larger population—all needing European goods.

The date palm is rightly called the monarch of the Sahara, but it has subjects. A great variety of fruits—peaches, grapes, oranges, figs, and the more hardy apple, etc.—are grown in the oases, and there are possibilities of

a valuable export trade in them. Moreover, a large range of crops from wheat and barley to rice and durra can be grown. These will not become exports but if all the chances of cultivation were seized the Sahara could support a much larger population than it now does. Two things are requisite for the cultivation of the oases to their fullest capacity—water and security of tenure. The French are providing both. Besides the sinking of artesian wells, the usual method of getting new supplies of water in the oases, surface irrigation works are being undertaken in Tuat where there is a large supply of river water.

Another source of sylvan wealth is afforded by the gum acacias. These are found in oases but chiefly in the intermediate zone bordering the Sudan. In these regions too are found the ostriches whose feathers have for centuries been one of the chief articles of Saharan commerce. There is no reason why ostrich farming in this "strip of herbage strown" should not become very valuable. In Mauritania many of the uplands appear to be suitable for stock-raising on a large scale and Port Etienne and Villa Cisernos afford convenient harbours for their export. The thousands of camels, asses, goats and sheep possessed by certain tribes proved the existence of large areas of pasturages. The present trade in hides and skins is obviously capable of material expansion. Probably esparto might be cultivated here as it is in the Algerian plateaux, and Mauritania with its harbour of Port Etienne seems to deserve to be supplied with a railway system.

Although the Sahara may be the least curable of deserts, actually the area where increased cultivation of the soil is possible and would be profitable is large. It cannot well be less than a tenth of the whole area—say 350,000 square miles, or something less than the combined area of France and Spain. This would include the Sahel Sudanese, the intermediate zone mentioned several times already. There appears to be no sufficient climatic reasons to prevent Fezzan, the Zinder district, the Aïr highlands, and the Walata valley recovering the prosperity they formerly possessed. The region of the Middle Niger—the backwaters and lakes which extend westward of Timbuktu—could at comparatively little cost be placed under irrigation. Means could in all probability be found for resorting to cultivation of large areas between Lake Chad and Borku. In the bed of the Bahr el Ghazel wells already exist and their number could be increased by boring. Efforts to regenerate the intermediate zone are, naturally, likely to take second place to the development of the richer regions further south, but work in that zone has the recommendation that it will form a protection against further encroachment by the desert.

As to mineral wealth the Sahara is rich in salt. Phosphates, potash and soda are found; the great beds of phosphates exploited in Algeria and Tunisia lie on the Saharan border. There is a regular export of potash from Aïr to Nigeria. Gold and precious minerals were mined by the ancient Egyptians in the hills facing the Red Sea and gold-mining on a small scale has begun again in the Nubian Desert. Soda in large quantities is obtained from the Natron lakes west of Cairo, from the Chad district and other regions. Petroleum-bearing strata are believed to exist. But the mineral resources of the Sahara are practically unknown, though the belief that they are great is probably well founded.

When all has been done for the economic development of the Sahara which is possible, when France, Great Britain, and Italy between them maintain peace throughout its wide extent, when a population ten times as numerous as it now is finds in it means of support, the desert will in outward aspect be little altered. It will remain a land of immense solitudes and boundless horizons, of strange dead mountains and dry river-beds, of verdant oases, waving palms and ever-receding mirages—a land of heat and thirst, of rock and dune, in which the tents of the nomads and the caravans of camels will leave a more lasting impression than the lines of steel which bind it anew to the outer world.—THE GEOGRAPHICAL JOURNAL.

THE WAR AND GERMAN AGRICULTURE.

So much has been and is being written on the real or imaginary shortage in Germany of food commodities that it is well that an official statement should be issued. Such a statement appears in the JOURNAL OF THE BOARD OF AGRICULTURE (November 1915), but is, unfortunately, unsigned. Hence it is difficult to estimate the value of the conclusions which it contains.

From the article we learn that in normal times Germany imported only about one-tenth of her feeding stuffs for man and beast, but that, inasmuch as war was declared before the harvest had been gathered in, the deficiency —owing to mobilisation—was greater than one-tenth.

On the other hand, much of the food normally destined for feeding of stock is suitable for human consumption—barley, oats, potatoes, etc. Hence by slaughtering a sufficient number of animals scarcity might have been prevented. This was not done until actual scarcity had declared itself, but in January, 1915, the danger was recognised and steps taken to reduce the number of swine. Potatoes, of which Germany produces a quantity greater than that raised by any other country, might have served to repair the deficiency, but in the earlier days of the war farmers were encouraged to feed their surplus to stock, and it was not till later that it was realised by the authorities that the potato stocks, properly handled, would serve to make good the deficiency in corn.

The patriotism of the German was not sufficient to overcome the desire on the part of those holding potatoes to make large profits, and on the Government deciding to purchase potatoes at a certain price, only small quantities were forthcoming. Farmers were holding their stocks in the hope of better prices. Later on, after a bout of speculation, there was a potato panic ; prices fell, and the Government potato department found large stocks left on their hands. Much of this surplus was used, however, for the making of dried potato flakes, which are of good keeping quality. This year's harvest is not believed to be up to normal, owing to shortage of labour and draught-animals and scarcity of nitrogenous and phosphatic manures.

Elaborate measures have now been taken to ensure the most economical application of foodstuffs, by regulating the feeding of stock, fixing minimum prices for wheat, rye, etc., prescribing rations for dwellers in towns, drying large quantities of potatoes and reserving them until spring and making large use of the forests as feeding-grounds for pigs.

The article concludes with the comment that although they blundered at the beginning the officials have displayed energy and competence in dealing with what was and no doubt is a difficult situation.—GARDENERS' CHRONICLE.

MOTOR PLOUGHS AND TRACTORS.

As a result of suggestions made by the Board of Agriculture and Fisheries demonstrations of labour-saving machinery have recently been carried out by the County Councils of Lincoln (Lindsey), Essex, and Northants, the Suffolk Agricultural Association in conjunction with the East Suffolk County Council, and the University of Cambridge. (Since the date of writing, another demonstration has been held in Yorkshire under the auspices of the Yorkshire Agricultural Society and the Yorkshire Council for Agricultural Education.)

Although such labour-saving devices as potato diggers, dung spreaders a turnip-topping and tailing machine, a turnip thinner and horse hoe, a root cleaner and cutter, a hedge cutter for horse power, a pig-feeding machine, milking machines, and model silos were exhibited, the demonstrations had regard chiefly to motor ploughs and tractors.

From the point of view of the attendance and interest aroused on the part of farmers, the demonstrations were all extremely successful; thus, it is estimated that over 1,000 people were present at each of the two demonstrations in Lincolnshire, and at Chelmsford the attendance numbered some 400 to 500, including members of the Departmental Committee on the Home Production of Food. Several hundreds were also present at the other demonstrations.

The conditions under which the trials of motor ploughs and tractors took place were, perhaps, too favourable for definite conclusions to be formed as to the general usefulness of the various machines. The weather was fine in all cases, and the land generally dry; the soils were, as a rule, light, but in the Cambridge demonstration the soil was a heavy loam, in places changing to a heavy clay, and in others to a lighter loam. It must, of course, be remembered, on the other hand, that wet weather need not seriously interfere with the employment of motor ploughs and tractors, since the work may be done sufficiently quickly to be accomplished in spells of fine weather. It is probable that the motor ploughs and the lighter tractors will usually be workable under the same weather conditions as horse-drawn ploughs. The soil in the Cambridge demonstration was so hard that it was doubtful whether horse ploughs would have worked successfully. Cross ploughing, and the ploughing-in of dung, were not tested in these demonstrations.

The number of machines tested was affected by the difficulty experienced by manufacturers in supplying machines and men, and by difficulties of transit. In some cases the railway companies were able to afford special facilities for delivery.

The prices of the motor ploughs (combining plough and motor in one) tested are lower than those of the tractors (i.e., without ploughs); the motor plough would probably be most suitable where the ploughing can be spread over several months. On the other hand, the tractor is favoured where large areas have to be ploughed quickly, and where there is much haulage and threshing to be done.

Various particulars as to the motor ploughs and tractors are given in the table on the next page.

Demonstrations of the FOWLER-WYLES MOTOR PLOUGH were given at Frithville (Lincolnshire), and Bramford (East Suffolk), at both of which places it did good work. The motor drives two spiked wheels, and is very simply controlled with one lever by a man sitting at the rear; the plough may be used for either single or double-furrow work. Its small size (3 ft. high by 2 ft. 4 in. wide) allows of its employment in hop gardens and orchards where horses are less suitable. It seems to be capable of ploughing about 3 acres per day. Various kinds of farm work other than ploughing, e.g., cultivating are possible. When not in use in the fields the engine may be used for grinding, chaff cutting, etc.

The WYLES MOTOR PLOUGH is similar in type to the foregoing, and is adapted for the same kinds of field work. It is, however, fitted with a more powerful engine. It did very good work at Chelmsford. A suitable pulley is attached for belt driving.

Name.	Manufacturers.	H.P. (h.p. at drawbar in brackets.)	Weight.	Fuel.	Plough.	Price.
Motor Ploughs.			T. C.			£
"Fowler-Wyles" Plough -	John Fowler & Co., (Leeds), Ltd. -	8—9	16	Petrol or benzol.	2 furrow	158
Wyles Motor Plough -	Wyles Motor Ploughs, Ltd., Manchester -	11—12	1 2	,, ,,	2 ,,	172
Martin's Motor Plough -	Martin's Cultivator Co., Stamford -	15—16	—	Petrol	2 ,,	200
Crawley's Motor Plough -	Crawley Bros., Hadstock - -	30	1 10	,,	3 ,,	—
Tractors.						
Weeks-Dungey "Simplex"	Weeks & Son, Ltd., Maidstone -	22½	1 5	,,	2-3 ,,	210
"Big-Bull" or "John Bull"	(Agents) Cyrus Robinson & Co., 61, Holland Road, London, W. -	20 (7)	2 0	,,	3 ,,	230
"Mogul" - -	International Harvester Co., London-	25	4 5	Paraffin or petrol	3-5 ,,	400
"Daimler" - -	Daimler Co., Ltd., Coventry -	40	4 10	Petrol	4 ,,	600
Saunderson's "Universal" Model "G" -	Saunderson & Mills, Ltd., Bedford -	20	2 15	Mineral spirit or paraffin	3-4 ,,	325
"Sandusky" - -	(Agents) Mills & Son, Ltd., Paddington	brake 40—45 (15)	3 10	Petrol	4 ,,	578
"Overtime"	Overtime Farm Traction Co., London	24 (12)	2 3	Paraffin	3 ,,	231
"Ivel" - -	The Ivel Agricultural Motors, Ltd., Biggleswade - -	24	1 17	,,	3 ,,	265
Mann's Steam Tractor -	Mann's Patent Steam Cart and Wagon Co., Ltd., Leeds -	—	4 10	Coal or coke	4 ,,	—
Ransome's Steam Tractor -	Ransome, Sims & Jeffries, Ipswich -	—	4 15	,,	4 ,,	—

Martin's Motor Plough was exhibited at Frithville, Appleby (Lincolnshire), Cambridge, and Bramford, and did good work. The feature of this machine is that it obtains its motion from an endless chain or "creeper" 6 in. wide, giving a 3-ft. continuous tread. There is a creeper on each side, and the one in the furrow has a tendency to break up the soil rather than solidify it. The creeper device worked well on dry, light land, and when the plough was replaced by a cultivator the engine drew this readily through the freshly-ploughed ground without injury to the soil. At Appleby, although some time was occupied in examination and enquiries, it ploughed 1½ acres in 4 hours (double furrow).

Each of the foregoing machines is easily worked by one man; the consumption of petrol per acre varies from about 1½ gal. to 2½ gal. They can turn readily on a 4-yd. to 5-yd. headland, and appeared to be better adapted than tractors for small fields, hilly land, and land on the ridge-system.

Crawley's Motor Plough, also self-contained, and manipulated by one man, did excellently at Chelmsford, and attracted much attention at Cambridge, where it worked powerfully, and drew a 3-furrow plough on all the classes of soil at considerable speed. It has evidently plenty of power, and is capable of ploughing the heaviest classes of soil satisfactorily. It seems easy to control, and requires a narrow headland.

The Weeks-Dungey "Simplex" Tractor.—This is a compact machine, measuring 7 ft. 4 in. long by 4 ft. wide, and 4 ft. 9 in. high; it was generally liked at the Frithville demonstration for its compactness, and was, in fact, one of the best of the small type machines. Three speeds forward, and one reverse are provided, and, although some doubt was expressed at Frithville as to its ability to work in wet weather without slipping, the makers claim that the speed attachments overcome this difficulty. At Frithville, Appleby, Cambridge, Northants, and East Suffolk (the demonstrations in which it was tried) it did good work, and required very small headlands. Under the conditions in which it was tried, the engine was easily capable of pulling the double-furrow plough, although not so fast at Appleby as the "Bull." The machine appears useful for slow haulage work; it is said to be able to pull 5 tons on the level. Two men were required for ploughing.

The Big Bull Tractor is a 3-wheeled machine with a powerful engine, capable of pulling a 3-furrow plough; its length is 13 ft. 11 in., and height 6 ft. 3 in. The driving wheel and the single-steering wheel run in the furrow, and do not pack the land.

Some Lincolnshire farmers thought that this arrangement of the driving and steering wheels, although generally commendable, might be disadvantageous under certain conditions by consolidating the furrow bottom too much; on the other hand, it was noted at Cambridge, on the heaviest part of the land, that the single-tractor wheel in the furrow seemed inclined to churn up the subsoil.

The fact of the driving wheel running in line with the steering wheel makes the tractor automatically self-steering; it only needs driving round the ends. The tractor required 2 men to handle in the demonstrations, though the makers claim that 1 man can do the work when their own plough is fitted.

At Cambridge the tractor drew a 2-furrow plough, and ploughed a greater area than any other machine, working steadily through the day. At Appleby, 3 acres of land were well ploughed 5 in. deep in 4½ hours; in a test in Lincolnshire earlier in the year, 1 acre was ploughed in 1 hour 50 minutes, a little over 2 gallons of petrol being consumed. The tractor left a narrow headland at Appleby, but was not particularly handy at the headland at Cambridge.

A point which was not tested was as to whether a 3-wheeled tractor is desirable for really stiff soil. Further, in Lincoln, the question was raised as to whether a 3-wheeled tractor is equal to a 4-wheeled one for haulage purposes, but apparently the draw chain adjustment at the back permits of an even and direct pull, and the single steering wheel is no advantage. The question of backing the machine might be a difficulty in reaping.

A feature of the machine is the ease with which the working parts may be inspected.

The Mogul Tractor is a very powerful machine pulling a 4-furrow plough. It is started on petrol, and runs on paraffin. It has 2 speeds forward, and 1 reverse. It is easily handled, having a steering mechanism of the motor-car type; all the working parts are well protected. It was tested at Frithville, Chelmsford, Moulton (Northants), and Bramford, and did good work. On account of its heavy weight, however, the wheels are apt unduly to pack the land. It was rather slow at Frithville, and, although ploughing 4 furrows against the "Bull's" 3 furrows, it did not get so much work as the latter. It is too heavy a machine for small occupiers, and probably too expensive for ordinary farmers. The tractor can haul 10 tons on level roads.

The Daimler Tractor is another machine which is very heavy, and expensive for ordinary farmers; the makers intend to turn out a smaller and lighter machine after the war. However, it did very satisfactory work at the Lincoln demonstrations (it was not tried elsewhere), ploughing about 1 acre per hour. It pulls a 4-furrow plough. No delivery of these tractors can be obtained at present.

The Saunderson and Mills "Universal" (Model G) Tractor was tested at Frithville, Chelmsford, and Moulton. It was regarded, both at Frithville and Chelmsford, as an exceedingly useful general purpose machine, and it seems to be one of the best of the more expensive types. An advantage is that it works on paraffin, the consumption of which, in ploughing, was put at 3 gallons per acre at Moulton, and about 4 gallons per acre at Chelmsford. The 1915 type of machine is stated to be a great improvement on older types. At Moulton it drew a 3-furrow plough at the rate of about $\frac{3}{4}$-acre per hour. It has 3 speed gears of approximately 2, 3, and 5 miles per hour forward, and 3 reverse speeds. It will haul a load of 5 or 6 tons at the rate of 5 miles per hour, and drive a 4-ft. 6-in. threshing machine.

The very powerful *Sandusky Tractor* was tried at Frithville, and pulled a 4-furrow plough with ease; the plough was fitted with a patent lever apparatus for lifting all the ploughs out of work, and letting them in again at the headlands, which does away with the necessity of a man at the ploughs. This tractor again seems too heavy and expensive for the ordinary farmer. It did much less than 1 acre per hour at Frithville. The wheels skidded on the loose soil surface when a trial of deep ploughing (10 in.) with a 3-furrow plough was carried out.

Good work was done by the *Ivel Tractor* at Chelmsford. This tractor has been before the public for 11 years, and its merits are well known.

The *Overtime* was tried at Moulton and Bramford, its work being very favourably commented upon. It drew a 3-furrow plough with ease, but required 2 men. As a light tractor at a moderate price it appears to be one of the most useful on the market.

Ransome's Steam Tractor was tried at Bramford. The soil, though light, was somewhat soft as a result of heavy rain the day before the trial, and the tractor was unable to demonstrate its powers. On firm, level land, however, there is reason to believe that this tractor is capable of doing good work.

The *Mann Steam Tractor* pulled a 4-furrow plough at Frithville, and did good work, but it is generally held to be more adapted to road work than ploughing. However, it ploughed evenly and well, and satisfied many of the larger farmers.—JOURNAL OF THE BOARD OF AGRICULTURE.

PROGRESS REPORT, PERADENIYA EXPERIMENT STATION.

From October 15 to December 15, 1915.

TEA.

The yield for the month of October was 2,271 lb. green leaf and for November 4,553 from 5 acres and tippings. The October made tea fetched in Colombo 45 cents per lb., for broken orange pekoe, and an average of 39·11 cents for all grades. That for November 57 cents per lb. and an average 49 of 49·23. All fifteen plots are now in full bearing.

RUBBER.

Plots 73-77 have been thickly sown in cow-pea to be cut and mulched to the trees before the dry weather.

In November the Tephrosia candida in all other plots was cut and mulched for the eleventh time.

31 trees have been attacked by bark-rot; the method of prevention is under discussion.

COCOA.

Pickings have continued fortnightly. Pod fungus has shown a remarkable decrease over last year in all the plots. In plot 1 for October and November, 1914, there were respectively 50 and 470 fungus pods and in 1915, 132 and 122. In plot 2 for October and November 86 and 900 in 1914 and 144 and 40 in 1915. The rainfall for October and November, 1914, respectively was 11·87 in. and 7·41 in. and for 1915 5·88 in. and 12·21 in. It will be noticed that as regards amount of rain the months changed places in 1915. In 1914 there was heavy rain in October and less fungus pod and in November less rain and more fungus. This is as it should be as the fungus engendered by the wet October would manifest itself the following month. But in 1915 the comparatively small rainfall in October resulted in a decrease of fungus pods in November.

The decrease is therefore probably largely due to the dadap shade having been heavily lopped in October just before the North-east Monsoon, and to regular fortnightly pickings preventing the spread of the fungus.

COFFEE.

The dadaps in the new plots have been pruned and the loppings mulched to the young trees. The young plants show a healthy growth in spite of the green-scale which is being kept in check by spreading the fungus *Cephalosporium*. Some coffee leaves bearing this fungus have been sent to a planter near Kandy whose new coffee plantation was becoming infested with green-scale. He writes:—"In three days the fungus began to spread and on the fourth day had travelled to a bush 50 feet away." Further progress will be reported later on.

Twenty-five plants of Arabian coffee have been received from Hakgala Gardens and planted 10 ft. x 10 ft. under dadap shade.

The Hybrid bushes round the show plots are being cropped. The bushes are divided into those most resembling the Arabian parent and those the Liberian, in order to test the flavour. One bush yielded a crop of 11½ lb. green berry at one picking which, when sun-dried, gave a weight of 5¼ lb.

COCONUTS.

All the plots in the young palm plantation have been well disced and cleaned and the older palms are in heavy bearing. All mana-grass has been pulled up again for the third time on the hill-side.

PADDY.

The field continues to look in first-class condition. During a very heavy rain-storm the drain worked very well in carrying off the storm water quickly and preventing any flooding or beating down of the crop.

The Hondarawala paddy is in flower, 99 days after sowing. The plot has been badly attacked by the rice-bug (*Leptocoriea varicornis*). All grass and weeds on the banks are being cleared away and on the advice of MR. HENRY, Acting Government Entomologist, trials with nets to sweep over the fields to catch the pests are being made. Results and further details will be published later on.

PLANTAINS.

The Hondarawala variety, hitherto immune from the banana disease (Fusarium) has now been attacked.

PAPAW PLOT.

The tapping for papain has now been discontinued as the trees were getting too tall and the number of fruits very few. A total quantity of 19 lb. was collected and sold for Rs. 3/50 per lb. The results will be published later.

ECONOMIC PLOTS.

Four varieties of cotton have been sown, Sea Island, Durang, Allen's Long-Staple and Cambodia.

The groundnuts were harvested in 5 months from sowing and the plots re-sown with the addition of Mauritius variety. The Spanish variety gave very fine large nuts, the Ceylon, a medium sized one, and the Virginia Bunch the smallest.

The small yield from Virginia Bunch is probably due to the fact that the seeds were not sown close enough and the plants should have been earthed up to counteract their erect habit of growth, which prevents the flowers from being able to form their seeds in the earth.

The following is the result :—

Spanish Nuts.

316 sq. yards gave	74	lb. fresh nuts
	23·5	,, dry ,,
	50·5	,, loss on drying, or 68·2%

This yield is equivalent to 1,135 lb. of fresh nuts or 360 lb. of dry nuts per acre.

The nuts consisted of shells 31·3%
kernels 68·7%
so that the yield per acre of dry kernels equalled 247 lb.

Virginia Bunch.

264 sq. yards gave	27·50	lb. fresh nuts
	15·75	,, dry ,,
	11·75	,, loss on drying, or 42·7%

The yield is equal to 506 lb. per acre of fresh nuts or 290 lb. of dry nuts. The yield per acre of dry kernels equalled 199 lb.

Ceylon Variety.

159 sq. yards gave	98·00	lb. fresh nuts
	51·25	,, dry ,,
	46·75	,, loss on drying, or 47·6%

The yield is equivalent to 2,980 lb. of fresh or 1,560 lb. of dry nuts per acre. The yield per acre of dry kernels was 1,071 lb.

The last plot of 159 square yards or about 1/30th of an acre cost Rs. 1/74 to hand dig and gather the crop of 51¼ lb. of dry nuts. Taking one bushel of unhusked nuts at 24 lb. the cost per bushel equals 78 cents; so that 1,560 lb. or 68 bushels would cost Rs. 50/- per acre.

Allowing Rs. 2/50 per bushel as the value of the dried nuts, the return per acre is Rs. 170/- less Rs. 53/-, or a net profit of Rs. 117/- per acre.

Taking the cost of digging and collecting as the same in each case, the respective profits per acre would be, assuming the percentage of oil being the same in each case :—

	Yield per acre bushels	Weight per bushel lb.	Costing Rs. c.	Value Rs. c.	Profit per acre Rs. c.
Spanish Peanuts...	21	17½	16·40	39·00	22·60
Virginia Bunch...	12·6	24	9·80	31·50	21·70
Ceylon Variety...	68	24	53·00	170·00	177·00

A determination of the percentage of oil in the seed and of nitrogen, etc, in the cake of each kind is being made.

VANILLA.

Several of the vines flowered in October and November, but the spring is the usual season. Those that flowered in May are ready for harvest.

The Temple-tree cuttings (Plumeria) planted to take the place of the dadaps have now become well established and the vines are gradually being transferred to them whilst the dadaps are being lopped down and mulched to the plants.

The Plumeria has also made a good growth in that portion of the plot where the soil is so poor that the dadaps failed to become properly established.

A plot of Sesbania grandiflora (agati) has been sown to act as supports for vanilla, pepper, and betel with T. candida intersown to see the effect of green-manuring on these vines, which should respond readily to a green leguminous mulch.

DUDLEY S. CORLETT,
Manager, Experiment Station, Peradeniya.

MILK FEVER IN DAIRY COWS.

A. A. JOHNSON.

Firstly let me say definitely that the term "milk fever" is a complete misnomer, because the "fever" is conspicuous by its absence in this disease and the thermometer registers as a rule a temperature that is subnormal, indicating the complete collapse of the body functions. A better description of the disease is that of parturient apoplexy, or parturient collapse, the former designation implying an unconscious following on the act of calving, the latter a collapse at this period.

This disease has been described by writers for upwards of a century, and has at the present moment become increasingly prevalent, thanks to the improvement in the milking qualities of the dairy cow, and the life of ease

that it leads. Still even to-day we are in doubt as to the actual causes that bring about the condition. Scientists in all lands have argued and experimented, but a combination of circumstances having to be present to bring about an attack, it would seem that to any one of the factors might be correctly ascribed the causation of the disease. The extraordinary success attending the treatment of the udder would lead one to believe that the starting point of the disease lies in that organ, while the ensuing symptoms of brain disturbance and paralysis of the nerve centres would also support the theory that the blood and nervous systems were affected to a great extent.

A review of the symptoms is unnecessary, but the fact may be stated that certain conditions influence the onset of the trouble, and that farmers keeping their cows under certain conditions may expect some of them to develop the disease at some period or other. The prevention of parturient collapse or milk fever is really of more importance than its treatment. The cows attacked are usually deep milkers, and the third calving is the most likely period for commencement. Thereafter, each calving may produce symptoms more or less serious according to the condition of the cow. A plethoric, rich state of the blood seems to be a necessary adjunct, while want of exercise is also one of the predisposing causes. I do not think any one breed is more predisposed than another, and though possibly more Jersey cows are affected than other breeds, the fact that this breed is largely kept by the "one-cow-owner," and therefore is more likely to be overfed, accounts for the increase. Milking the cow dry is undoubtedly a predisposing factor, and is obviously a disregard of nature's intentions.

As regards treatment, the injection of air into the udder is now so well known and its beneficent results so widely distributed that one need hardly refer to it, except to remind owners of cattle that are likely to be affected that there are many forms of apparatus on the market which can be obtained at a small cost. These render unnecessary the introduction of germs into the udder, with the consequent loss of a quarter so often experienced after the use of a bicycle pump and valve. The air introduced should be sterilised by being passed through aseptic wool, the teat syphon boiled before introduction, the udder well washed and cleansed with antiseptic. Then the milk should be withdrawn from the udder, which is then distended with air. After distension it is usual to tie the teats to prevent its egress, but in many cases this is unnecessary, as the mechanism that prevents the egress of milk will, as a rule, prevent the emission of air. However, if the teats are tied with tape, see that it is in the form of a broad band, and do not leave it on for more than a few hours. Removal of the urine and the administration of an enema of warm water should never be omitted. The cow should be turned from one side to the other every few hours, and packed up so that she cannot lie stretched out upon her side. The injection of air should be repeated in about eight hours' time if the cow does not rise, and no medicine should be administered by the mouth, as this practice accounts for the majority of deaths under present-day treatment. The air treatment should be persevered with as long as any brain symptoms are present, and no case need be looked upon as incurable unless the animal becomes completely paralysed.

A cow having once suffered an attack of the disease is liable to another turn unless carefully dieted and exercised previous to calving. There is no doubt in my mind, and I have had experience of some thousands of cases of "milk fever," that if the calf were left with the cow for a few days after calving, or that, if it was taken away, the cow were never milked dry, but the action of the calf imitated, the number of cases would be largely reduced. However, the great preventive is the imitation of natural conditions, by avoiding over-feeding and the exercise of all deep milking susceptible animals.—CANTERBURY AGRICULTURAL COLLEGE MAGAZINE.

PROGRESS REPORT OF THE DRY ZONE EXPERIMENT STATION, ANURADHAPURA.

(From 15th October, 1915, to 15th December, 1915.)

The Acting Manager has made four visits since last report. The barbed wire fence has now been completed right round the 40 acres so that the cattle nuisance should now cease.

Three acres have been planted out 22 ft. 22½ ft. with oil-palms (Elæis guineensis) from the nursery in holes supplied with cattle manure. Germinated cow-peas have been intersown to improve the soil. These palms will be kept under irrigation throughout the dry season. Two plots have been planted with Gliricidia maculata cuttings for shade plots for coffee.

All the plots in the trial ground have been resown with the seed saved from the crops of last February but are not germinating at all well; this is partly due to heavy rains and partly perhaps to loss of vitality in the originally imported seeds.

The only plots which are really doing well are those sown from the fresh seed sent from Peradeniya of red and pink dura and cow-peas, which are making a very luxuriant growth.

Six plants of Grape fruit raised in Peradeniya from seed have been added to the citrus plots. All plants have been well formed with cattle-manure.

The pines have been forked and manured with cattle-manure and ashes and look well.

The two grape vines have been pruned and are making good growth.

The sugar-cane plot has been cut and refilled up and manured for ratooning.

The betel vines have been cattle-manured and pruned, but are making very poor growth. The plot has been extended and Sesbania grandiflora sown as supports.

Two plots of cotton, Sea Island and Cambodia, have been sown.

The tobacco in the nurseries is germinating well.

All the plots reserved for tobacco have been sown with beans for plough ing in to improve the soil.

All drains have been considerably deepened, but even now many of the plots have suffered by flooding in the heavy rains, the resulting stagnant water killing the crops.

Owing to retrenchment, no more land will be levelled and stumped, so that after the tobacco crop has been established it will be possible considerably to reduce the coolies.

DUDLEY S. CORLETT,
Acting Manager,
Dry Zone Experiment Station.

RECORD OF PLOTS.

No. of Plot.	Date of Sowing and Planting.		Name of Crop.		Remarks.
2	23-10-15	...	Vigna catiang	...	Medium
3	,,	...	Pigeon Pea	...	Half the stump dead
4-15	,,	...	Cow Pea	...	Good
16	,,	...	5 months dura	...	Medium

17	23-10-15	..	Dura white	...	Good
18	,,	...	Dura yellow	...	Medium
19	2-11-15	...	Sun flower	...	Good
20	23-10-15	...	Sorghum red	...	,,
21	,,	...	Sorghum white	...	Medium
26	2-11-15	...	Dura pink	...	Good
27	23-10-15	...	Maize red	..	Medium
28	,,	...	Maize golden yellow	...	Good
29-30		...	Sweet potato, old	...	Failure
31	3-11-15	...	Egyptian clover	...	Poor growth
32	4-12-15	...	Sea Island Cotton	...	Newly sown
33	,,	...	Cambodia Cotton	...	,,
39	2-11-15	...	Green gram	...	Good
40	,,	...	Green gram	...	,,
41	25-10-15	...	Haricot beans	.	Medium
42		...	Sugar cane	...	Ratoons growing
43		...	Algaroba beans	...	Good
44-45	10-11-15	...	Black gram	...	,,
46	5 11-15	...	New betel	...	Very poor
56		...	Sour sop and mulberry	...	Good
57		...	Guava	...	,,
58		...	Pine apple, Kew	...	,,
59		...	Pine apple, Mauritius	...	,,
60	15-9-15	...	Bananas	...	,,
64		...	Pomegranate	...	,,
71	3-12-15	...	Green gram	...	,,
72	8-11-15	...	Red dura	...	,,
73	9-11-15	...	Horse gram	...	,,
74	,,	...	Horse gram	...	,,
81	8-11-15	...	Polong me	...	,,
85	5-11-15	...	Pigeon pea	...	,,
87	29-10-15	...	Cow pea	...	,,
88	11-11-15	...	Penusetum kamber	...	Medium
89	27-10-15	...	Red dura	...	Good
90	5-11-15	...	Bandakka	...	Medium
91	4-11-15	...	Cluster beans	...	Good
92	27-10-15	...	Green gram	...	,,
93	5-11-15	...	Linseed	...	,,
95	25-10-15	...	Pannicum frumentaceum		,,
96	,,	...	Kurakkan	...	Medium
97	3-11-15	...	Sun hemp	...	Not good
98	,,	...	Pannicum miliare	...	Medium
99	26-10-15	...	Setaria Italica	...	Bad
100	,,	...	Black gram	...	Good
101	,,	...	Kurakkan	...	Medium
102	2-11-15	...	Jute	...	,,
103	5-11-15	...	Cow pea	...	Good
104	27-10-15	...	Vigna catiang	...	,,
105	,,	...	Polong me	...	,,
106	,,	...	Horse gram	...	,,
107	26-10-15	. .	Voragan	...	,,
108	23-10-15	...	Sorghum	...	Bad
109	,,	...	Sorghum white	...	Medium
110	,,	...	Sorghum red	...	Good
111	25-10-15	...	Dura yellow	...	Medium
112	,,	...	Dura white	...	,,
113	,,	...	Dura	..	,,

THE NAMING OF PLANTS.

Precision was first given to the naming of plants by LINNEUS or VON LINNE, the great Swedish physician and botanist who lived in the eighteenth century. Based on sound principles, his binomial system of nomenclature persists in all essential particulars at the present day, and if employed with care and discretion, these binomial designations constitute perhaps the most scientific feature of biology. The names of plants as conceived by LINNEUS are of two kinds: those of the class and order which are *understood;* and those of the genus and species which are *expressed.* The name of the class and order never enters into the denomination of the plant, though at the same time it is always connoted. All plants agreeing in genus have the same generic name, and each generic name must be single; and further, two different genera cannot be designated by the same name. LINNEUS also laid down the rule that the best generic names are those which express the essential character or habit of a plant. In addition, he formulated other maxims concerning the etymological constitution of botanical names, limiting their construction to Latin and Greek: although many of these latter canons have been criticised as trivial and unimportant they are generally respected at the present day. In regard to the second or specific name, which is supposed to point out the particular species of each genus, we should again remember that those which indicate a decided specific character are the best. A good example of an intelligent specific name is found in *Panicum maximum*, where the generic name denotes the characteristic inflorescence of the genus, and the specific name the idea of size. To designate a variety, it should be mentioned that a third name preceded by the abbreviation 'var." is used after the second or specific name.

It is not unusual to use the name of a person as a specific name (spelt in the case of botanical, but not of zoological names, with a capital letter) in the possessive case, as *Thrinax Morrisii*, and in the case of all botanical and zoological names, the name (generally abbreviated) of the authority should be attached to them in order to avoid confusion in connexion with synonyms, thus *Saccharum officinarum*, L. This question of synonymy is a wide subject of the greatest importance in biology. We cannot in the space of this article presume to discuss it at any length, but one or two aspects may be referred to.

Amongst the flowering plants our present knowledge of systematy is sufficiently definite as regards genera for there to be little confusion possible in that connexion. But in the case of specific names it is otherwise, and it is quite common to find the same plant called by different names in different places by different botanists. For this reason the critical revision of genera is a very important branch of pure botany. The trouble lies principally in two directions. First, opinions differ as to what shall constitute a specific difference. Amongst systematic biologists we find two more or less distinct classes of observers who labour under the jocular but expressive names of 'lumpers' and 'splitters.' A 'lumper' is a botanist who shows a tendency to group closely allied forms under the same name, while a 'splitter' exhibits a tendency in the opposite direction, namely, to separate forms of close resemblance under different specific names. Either extreme is wrong, but in the light of modern biology, the tendency to excessive subdivision is perhaps the worse. The point is that a so-called species is not a fixed entity; species are constantly changing by slight mutations, or by acquired variations; and a specific name at best is but a provisional and temporary designation. The second reason for confusion in specific names lies in the circumstance that a describer may not be familiar with the work of others in different countries. This obstacle is being gradually overcome by increased facilities

as regards literature and the exchange of specimens ; but there still remains a need for more 'central clearing houses.' It should be remembered in the present connexion that the Royal Botanic Gardens, Kew, perform an important service of international influence in the matter of botanical nomenclature. The publication of the INDEX KEWENSIS has enormously reduced the confusion resulting from the existence of synonyms. The work goes on from year to year, and supplements of this remarkable index are issued at convenient intervals. In its pages the names which stand are printed in Roman type, while the synonyms appear in Italics. It is one of the indispensable works of systematic botany.

If we turn to the lower plants, especially the fungi, we find a much greater want of precision than amongst the flowering plants. The classification of the fungi is unfortunately artificial in many respects ; nor can this be wondered at, considering their comparatively simple structure. Morphological differences are often very minute and slender, and we not infrequently have to depend upon such varying factors as colour and shape as means of distinguishing genera and species. In the case of fungi which are not highly parasitic, it is possible to decide upon specific differences by means of comparable cultures. The genus Fusarium, for instance, is being studied after this manner in the United States. Different forms of the genus from all over the world are being grown in culture media under the same conditions, and it is hoped by means of the observations obtained to decide what forms are distinct and what are similar. It will be readily realized how important it is to eliminate synonyms amongst the fungi, by considering the case of Die-back disease of cacao. The fungus causing this disease has been known under at least half a dozen different names in different parts of the world and it was only after a critical examination of the forms in the Federated Malay States that BANCROFT came to the conclusion that they were all one and the same organism, which he named *Thyridaria tarda*. The practical importance of a result like this is considerable. The distribution of the fungus becomes definitely known, and legislation can be introduced accordingly. Further, methods of control formerly recommended as applying only to one form of fungus of supposedly limited distribution becomes afterwards applicable, at any rate theoretically, to half a dozen which were at first thought to be distinct.

Generally speaking workers on the fungi are inclined towards the class of 'splitters' previously referred to. There is a tendency to name new species on slender differences, and what is perhaps worse, to split up unduly established genera. Some evidence goes to show that this has been done for the sake of self-advertisement rather than in the interests of science. It is desirable that when they occur, such tamperings should be ruthlessly exposed.

Having discussed in outline the origin, uses, and some of the dangers attendant on scientific naming, we may profitably consider next the corresponding features of common or vernacular names. It is a mistake to think that common names of plants and animals are necessarily unscientific. Many conform to the canon of LINNEUS, which says that names should express the essential character or habit of the plant, and are accordingly highly instructive. Examples of this are very numerous : thus, nut grass (*Cyperus rotundus*) is so called because of the little tubers on the roots of this plant. On the other hand, the name nut grass is unscientific on account of the fact that the swellings are not nuts but tubers, while the plant is not botanically a grass but a sedge. Less open to criticism is the name soap-berry (*Sapindus saponaria*), so called because the fruit of this plant will, when macerated in water, produce a lather like soap ; and again love vine (dodder) *Cuscuta* sp., named after its habit of parasitic embrace ; and sea-side grape

(Cocco loba uvifera), so called on account of its maritime habitat and the superficial resemblance of the ripe fruit to purple grapes. But the common or vernacular name has many serious defects compared with the scientific designation. In the first place a popular name tells us nothing about the class or order to which the species belongs, that is to say, it gives us no clue whatsoever as to its position or status in the classification of the vegetable kingdom. Further, there is the more serious aspect from a practical point of view, that even in the same place a plant may be known by more than one common name. Thus *Bryophyllum calycinum* is known both as Wonder-of-the World and Love Bush; *Borrichia arborescens* as Sea-side Oxeye, Sea-side tansy, and Samphire; and the common *Vinca rosea* as Old maid or Periwinkle. When we come to consider the matter from an international point of view, it becomes even more obvious that scientific naming is essential. Thus in the case of the genus of fruit trees designated Anona, the same species is called by entirely different names in various parts of the world, and it would be hopeless to attempt to use a popular nomenclature in writing of this group. That such should be the case is almost a foregone conclusion on account of foreign languages. In the West Indies, even, we find that the admixture of French and English, and to some extent Spanish, leads to great confusion in regard to vernacular names. The desirability of using Latin and Greek for scientific names is not, as LINNEUS thought, because these are less barbarous than the modern languages, but because the dead languages are more fixed and international.

The subject of scientific and vernacular naming is a wide one, but it is believed that in the foregoing we have referred to most of its principal aspects. It will be realized that if employed at all, it is essential to use scientific names intelligently, and with due regard to synonymy and the vernacular. Very frequently the common name is a quicker and better means of indicating a species than the scientific, though as a general rule it may be laid down that it is safer and more scientific to use both kinds of names. In this connexion we would call the attention of writers in the East to the fact that the employment of the Indian vernacular without the scientific, or at least the English equivalent, very often makes their literature quite unintelligible in other countries, which is a pity on account of the high standard and general interest of much of the Indian work. No reference has been made in this article to the pronunciation of scientific names as this is a matter which lies somewhat outside the present subject. If the continental system is unfamiliar to him, the beginner will do well to pronounce Latin in the same way as we should English, in giving the same value to the vowels. Accentuation and some of the consonants occasion a certain amount of difficulty, but very slight attention to the marks and directions to be found in many botany books will lead anyone to a correct pronunciation. It is hardly necessary to point out that a knowledge of the classical languages themselves is of great use in connexion with scientific names, and may be regarded as essential to those botanists and zoologists who are engaged in the study of systematy.—THE AGRICULTURAL NEWS.

PROGRESS REPORT OF THE EXPERIMENT STATION, MAHAILUPPALAMA.

(From 15th October, 1915, to 15th December, 1915.)

The 7th picking was done on 16th October, 1915. The number of nuts collected was 4,066 from 524 trees, an average of 6·48 per bearing tree or 2·43 per acre tree.

This gives a total of 19,105 for the year 1915 to date from an area of 23½ acres composed of Plot A 17 acres of 7 year old trees and Plot B 6½ acres of 8 year old trees (number of trees per acre 70).

In the irrigable area (7 year old trees) consisting of 1,224 trees, 464 trees gave 3,804 nuts, an average of 8·2 nuts per bearing tree.

The unirrigable area (8 year old trees) consisting of 60 trees, gave 262 nuts, an average of 4·36 nuts per bearing tree.

The eighth picking was done on 10th December, 1915. The number of nuts collected was 3,435 from 438 trees, an average of 7·8 nuts per bearing tree or 2·05 per acre tree. This gives a total of 22,540 nuts for the year 1915 to date from an area of 23½ acres composed of Plot A 17 acres of 7 year old trees (number of trees per acre 70).

In the irrigable area (7 year old trees) consisting of 1,224 trees, 402 trees gave 3,081 nuts, an average of 7·66 nuts per bearing tree.

The unirrigable area (8 year old trees) consisting of 36 trees gave 354 nuts, an average of 9·83 nuts per bearing tree.

The following figures have been obtained with regard to copra production :—

COMBINED PLOTS.

Picking.	Break nuts.	Rejections.	Copra lb.	No. of nuts per candy.
Sept.-Oct.	4,066	½ %	1,904	1,190
Sept.-Oct.	3,259	Plot A ½ %	1,789	1,015
Sept.-Oct.	251	Plot B 0	115	1,222

A consignment of copra, 1,699 lb., was sent to Colombo and sold on 3rd December, 1915, fetching Rs. 84·25 per candy which was the highest obtained.

DUDLEY S. CORLETT,

Acting Manager,

Experiment Station, Mahailuppalama.

CHLOROSIS IN PLANTS.

The preceding researches of the writer have shown that chlorosis can be produced experimentally in maize (*Zea mays*) by depriving the plant of sulphur or of iron ; the omission of manganese from the nutritive solution produces a partial decoloration of the leaves.

The first disease quickly disappears on providing the plant with the missing element, by applying it in the form of a very dilute solution to the blade of the discoloured leaf. The second disease does not yield to the action of manganese applied in the same manner ; but one drop of liquid exuded from the leaves of healthy plants will give the discoloured parenchyma a bright green colour in sunlight. Thus the liquid exuded by healthy plants contains an organic substance which cures diseased cells.

The active substance is specific : the exudations of cabbage, poppy and millet have no effect on this form of chlorosis in maize.

Thus, it is clear, there are several kinds of chlorosis which are distinguished from one another by their determining cause and by the treatment which causes their disappearance.

The most common form is due to lack of iron. This element, however, is very plentiful in the different kinds of arable soil. But limestone locks it up and hinders its absorption by a great many species of plants by alkalizing the excretions of their roots.

The carbonates of the alkaline earths without exception provoke chlorosis in plants susceptible to it. But it often happens that refractory species become chlorotic even in soils poor in lime. These anomalies form the subject of this article.

Transplanting may determine them: this operation destroys a large number of the fine rootlets bearing the absorbent hairs. Now, it is just these hairs which also constitute the excretory organs of roots and which render soluble the mineral elements necessary to the plant. Transplanting thus deprives the plant of certain indispensable substances, and especially of iron. This can easily be proved by placing upon chlorotic leaves a nitrogenous solution of iron of 1/2000. But the leaves become green again of their own accord as soon as the network of rootlets has reformed. Copious watering with a view to bringing about the recovery of the leaves only makes matters worse, since thereby, if the soil is rich in lime, the complete precipitation of the iron and its absorption by the calcium carbonate is brought about as the soil regains its usual amount of humidity; if the chlorosis persists, gardeners cure it successfully with a solution of sulphate of iron.

Cryptogamic diseases also promote chlorosis, even where the roots remain intact. Fungi are in fact active destroyers of organic acids; if the acidity of the descending sap is diminished, the excretions of the refractory plants become alkaline and their roots incapable of dissolving oxide of iron. The writer has observed the occurrence of chlorosis on maize plants cultivated in an aseptic solution each time that the culm was attacked by fungi, and especially by *Penicillium glaucum*. The decoloration of the leaves is sometimes complete. When the surrounding temperature rises above 30° C. (86° F.), the chlorosis disappears of itself, for high temperatures hinder the growth of the fungus and promote that of the maize.

Alkaline carbonates act in the same manner as the carbonates of the alkaline-earths, but more energetically.

Maize is refractory to the action of limestone; it becomes chlorotic in solutions rendered slightly alkaline by the addition of potash or soda.

Plant ash is very rich in alkaline carbonates and forms an excellent manure, but if it is applied in too large quantities it gives rise to chlorosis and often causes the death of the plants.

The alkalinity of the soil plays a large part in the absorption of iron by plants. The same may be said for manganese. Under natural conditions it is always the want of iron that makes itself felt, since plants require more iron than manganese.

The chlorosis observed by the writer on depriving the maize of manganese is, further, of a special kind. He has succeeded in reproducing it in plants of maize supplied with a complete nutritive mineral solution by exposing them to insufficient light. Out of ten clearly etiolated plants, three showed symptoms of chlorosis identical with that caused by the use of a solution lacking manganese. This disease is thus a characteristic of a pathological condition apparently due to various causes.

The special action of the exudation of healthy plants upon diseased individuals shows that plant cells, like the glands of certain animals, produce substances possessing special physiological properties.—BULL. OF FOR. AGRIC. INTELLIGENCE.

MEASUREMENT OF CATTLE FOR WEIGHT.

To arrive at a close estimate of the weight of cattle, mere guesswork is not reliable. There is, however, a rule by which the weight can be very accurately determined. There is one condition in connection with this method, which cannot easily be adapted to the guessing competition of the fat bullock, say, at the National Association's Exhibition at Bowen Park. That condition is that the competitor must be able to handle the beast, and this, of course, cannot be permitted, where the weight has to be arrived at by merely studying the build and condition of the animal

THE RULE IS—

Multiply the square of the girth by 5 times the length. Divide the product by 21. This gives the net weight of the animal in imperial stones of 14 lb. Or, to obtain the weight in scores, divide by 30.

EXAMPLE.

An animal girths 7 ft., and is $5\frac{1}{2}$ ft. in length.

The square of the girth is $7 \times 7 = 49$; 5 times the length is $27\frac{1}{2}$. Then $49 \times 27\frac{1}{2} = 1{,}347\frac{1}{2}$.

Divide this by 21. Result: 64 stones 2 lb., or 898 lb. Or, dividing by 30. Result: 44 scores 18 lb., or 898 lb.

If the animal is very fat, $\frac{1}{15}$ should be added to the weight thus obtained; if not moderately fat, $\frac{1}{15}$ should be deducted.—QUEENSLAND AGRICULTURAL JOURNAL.

THE CULTIVATION OF TEOSINTE
(EUCHLAENA LUXURIANS.)

D. J. G. VAN SETTEN.

Experiments at Moeara-Enim (South Sumatra) have shown that sowing without transplanting is the best method of cultivating this forage plant. One hoeing is then sufficient as interculture. The distance between the plants should be 20 to 30 inches. About one month after sowing the first cut can be made, and subsequent cuts can be effected regularly every month until six crops have been obtained. The total yield of green stuff was 13 tons per acre while the expenses amounted to about 3*s.* 9*d.* per ton.

For feeding, the daily ration was 80 lb. per head. This forage plant is recommended as a cattle feed on account of its high content of protein (10·6 per cent.) and carbohydrates (43·7 per cent.)—BULL. INT. INST. OF AGRIC.

NOTE ON OXALIS VIOLACEÆ
(MANICKWATTE WEED.)

This weed has been established on many estates in different districts for several years, and as the question was often raised as to its harmtulness to tea, the amount of growth and the nitrogen and mineral constituents removed temporarily from the soil were investigated.

A fairly thick growth of Oxalis 5" to 6" high was dug up with all bulbs from a measured area in tea of 41 square feet. The material was thoroughly washed free of soil and weighed 4·3 lb. It was then sun-dried, losing 63·1 per cent. as moisture. The sun-dried material was analysed for organic matter, nitrogen and ash constituents, the result being given below.

ANALYSIS OF (SUNDRIED) OXALIS VIOLACEÆ.

Composition	per cent.	lb. per acre.
Moisture	21·0 per cent	—
*Organic matter	71·5 ,, ,,	1,200 lb. per acre
+Mineral matter	7·5 ,, ,,	126 ,, ,, ,,
	100·0	
+Containing nitrogen	1·36 per cent.	22·9 lb. per acre
*Containing Lime	9·70 ,, ,,	11·9 ,, ,,
,, Magnesia	4·00 ,, ,,	5·0 ,, ,,
,, Potash	11·80 ,, ,,	13·8 ,, ,,
,, Phosphoric acid	9·60 ,, ,,	11·8 ,, ,,
,, Sulphuric acid	3·40 ,, ,,	3·7 ,, ,,

The Oxalis plant at the above thickness of growth supplies over half a ton of organic matter derived from the air and gives back to the soil when it dies back in dry weather the above quantities of nitrogen and ash constituents in an easily available form. As the above amount of growth is only a matter of a few weeks in favourable weather, the amount of organic matter returned to the soil annually if the ground is cleaned 3 or 4 times a year must be considerable and would result in a gradual increase of the valuable humus which is so important in the soils of Ceylon and most tropical countries.

It is evident that it temporarily removes some of the phosphoric acid and potash of the soil or the manures applied, but at the same time it prevents loss by drainage and returns the mineral matter in a form which is easily attacked and utilised by the roots of the tea. Although it is unsightly from an agricultural point of view and should be eradicated as soon as it first appears on an estate, evidence goes to prove that if it is established, it is better left alone, (all other weeds being removed), as the tea if properly manured does not fall off in yield. Scraping the soil as is commonly done is not only expensive, but increases the thickness of the subsequent growth; while if not touched, the plant dies down and disappears entirely at the beginning of the dry season, appearing again with the wet weather.

M. KELWAY BAMBER.

CEYLON WEATHER IN 1914.

There is a marked variation in climate between the different parts of Ceylon. In the low-country, with a mean temperature of the order of 80°F., a noticeable feature is the small range of both temperature and pressure; there is, however, wide divergence between the moist conditions in the south-west of the Island, where the average annual rainfall varies from 100 to 200 inches, and the dryzone areas of the north, north-west, and south-east.

Inland, with altitudes reaching 8,000 feet, the temperature is cooler and shows a bigger range; there is a corresponding change in vegetation, and the conditions are altogether more akin to those in the temperate zone.

RAINFALL.

The highest annual rainfall registered was at "St. Martin's Estate," Rangalla, which had a total of 178·93 inches, and 174 days on which rain fell. The lowest annual rainfall was at Mankulam, which had a total less than half its average, i.e. 26·01 inches in 90 days. The stations with the highest and lowest average annual rainfall are respectively Padupola, with 220·73 inches in 202 days, and Marichchikade, with 33·06 inches in 57 days. The longest drought occurred at Mantota, lasting for 143 days, May 9—September 28. The longest wet period occurred at "Duckwari Estate," Rangalla, lasting for 62 days, May 27—July 27.

The annual rainfall at Colombo (Cinnamon Gardens) was 74·26 inches in 181 days. At Kandy 78·90 inches were registered in 197 days, while the annual rainfall at Nuwara Eliya was 83·95 inches in 220 days. On the whole the annual rainfall was above normal in the north and east, and slightly below it elsewhere.

TEMPERATURE.

The highest average for the year was at Trincomalee 83·8°F., and the lowest Nuwara Eliya 60·4°F. At Colombo and Kandy the averages were 81·1°F. and 76·7°F. respectively.

The highest shade temperature recorded during the year was 101·2°F. at Anuradhapura on September 17. The highest on record is 103·7°F. at Trincomalee on May 12, 1890.

The highest shade temperature at Colombo in 1914 was 93·1°F. on February 10.

The mean daily range, i.e., difference between average maximum and average minimum, was highest at Nuwara Eliya (19·1°F.) and lowest at Galle (9·4°F.). At Colombo and Kandy it was 12·8°F. and 14·2°F. respectively. The absolute range, i.e., difference between actual highest and lowest readings, for the year was maximum at Nuwara Eliya (51·2°F.) and minimum at Galle (21·1°F.).—REPT. ON THE COLOMBO OBSERVATORY FOR 1914.

STUDIES ON DROUGHT IN RUSSIA.

One of the most important subjects of the work of the Odessa Experiment Station is the thorough study of drought and of the measures taken against it. In the study of the root system of cultivated plants, very interesting results have been obtained, especially as regards the method used for producing a full complement of roots. In the experimental field more than 40,000 determinations of soil humidity have been made, with a view to studying the circulation of water in the soil under different cultural conditions. The nature of drought, its causes, and the methods for dealing with it would seem to be as follows :—

Nature and causes of drought. (2) The depths attained by the root systems are from 27½ to 28½ inches in the case of potatoes, flax and some other plants, from 3 feet 3 inches to 3 feet 10 inches for most Gramineæ, 4 feet 10½ inches for sunflowers and mangels, and more for lucerne and other perennials.

(2) In order to ensure an abundant crop, the layer of soil containing the roots must be moist throughout its depth.

(3) The chief causes of the phenomenon of drought are: (a) the fact that towards the date of the spring sowings only a portion of the root-containing layer (at a depth of 1 foot 3 inches to 1 foot 7½ inches) contains

moisture—this is the general rule when a succession of grain crops is cultivated and with summer wheats with a fallow every third year. This lack of humidity in the soil is due to the fact that with cereals usually all the available water of the soil is already consumed towards the end of the growing period; this consumption is completed by the weeds which appear after the harvest, with the result that the depth of the moist layer in the spring depends exclusively upon the autumn, winter and spring rainfall, which is often quite insufficient; (b) the chronic lack of moisture over many years of the intermediate dry stratum of the soil lying beneath the upper and periodically wetted layer, and, as a result of this drying, the absence in that stratum of chemical processes transforming the insoluble mineral substances; (c) the great depth at which the lower, constantly wet stratum is situated, which results in the intermediate dry layer of the soil becoming especially thick.

Measures for combating drought. (1) The working (scarifying) of the stubble-covered surface as soon as the wheat is got in with a view to the greater accumulation and saving of the humidity derived by the soil from the late rains.

(2) The extermination of weeds;

(3) The forming of the black fallow, by means of which the intermediate dry layer of soil is moistened and disappears, or rather gives rise to a continuous damp stratum.

(4) A regular system of rotation founded, not only on the alternation of the crops themselves but also on the root systems (greater or less depth tapped etc.). This prevents the continued drying of the stratum containing the roots; some plants requiring the use of a cultivator, such as potatoes, flax, pumpkins, etc., do not use all the water available in the stratum occupied by the roots and therefore accumulate moisture for the following year.—BULL. INT. INST. OF AGRIC.

HOW YAMS MAY BE GROWN.

W. G. TAYLOR.

I have been asked to give an account of how I plant yams and make such a success of it, and I do so not because I have superior knowledge to the hundreds of other growers in Hanover, but because I know that there are many who would do better if they had the experience of others like myself who have, through failure and losses and successes arrived at methods that stand us in good stead.

To begin with I own the lands I cultivate and it might interest your readers to know that I did not inherit them but bought them out of the proceeds of cultivation, chiefly yam growing.

My lands are old cow pastures in which I run a few head of cattle and mules which I find very useful helps to my field, by way of supplying manure and firming the land and also making use of the weeds and grasses that grow up. By their use an old thrown up yam field converted into a pasture is ready to be replanted in from two to three years.

In taking up a piece of pasture for planting Lucea yams, I have the grass weeded and the hills dug in November and December. Forking is a new operation here and I have just begun with it, and I suppose from what the Instructor tells me I will get better results; that is left to be seen.

I do not dig two thousand hills to the acre as is done on rent lands, I consider that a "greedy choke puppy" policy to pursue. I find that 1,500 and even 1,200 hills are quite sufficient for an acre.

I make sure that my hills are well dug, deep and large, and that the place is well drained to prevent my yam hills being washed by heavy rains. The preparing of heads for planting is a very important part of the business. A head should be 4 lb. at least in weight, and in any case not much smaller, so that it may grow a vigorous and healthy sprout One in each hill is sufficient. When on account of scarcity of heads smaller ones have to be planted, two can be put to the hill.

Some yam growers believe in planting deep, but I find I get better results by shallow planting, so that portion of the head is exposed. The reason I think is, that when weeders are put to work they mould up the hills and cover the heads entirely, if they were planted deep, they will then become too deep and the result would be a poor crop.

A yam field should be weeded often enough to keep the ground free of weeds while the yam is growing and this might mean one, two or three weedings, according to soil and weather.

Now quite a good many planters cut their yams before they are ripe so that they may take advantage of a temporary good market or so that they may get large heads. By doing this a head may be not large enough to plant 4 hills. This is quite good enough for a man who is trying to increase his stock of heads, or for a beginner, but I plant yams that I may get food for myself and plenty to sell, and I want as good a yam as I can get. I allow the yams to ripen and then "slip" or "back" them, that is, I cut the yams and turn them in the hills without taking them out. They will keep thus for a long time if they are ripe and will be very good for eating. They will not make large heads, but they will make heads large enough to plant one or two hills each. In all kinds of yams I plant about 10,000 hills each year, which is not very large for a Hanover yam grower.

Good yams, that are well matured, will always be preferred in any market and I find no difficulty in selling mine to the exclusion of loads of unripe yams.

In conclusion I will tell your readers that I have always tried to follow the hints I get from the Journal and have found many of them very useful.—

JAMAICA AGRICULTURAL SOCIETY JOURNAL.

HOW THE BARK BREATHES.

Like all other living things, plants must breathe or they will not continue to live. The more highly specialised among them are therefore provided with elaborate respiratory systems, consisting of passages which conduct air to all parts of the plant, and openings on the surface, through which oxygen can be taken in and carbon dioxide given out; substantially as is the case with animals.

The external openings of this ventilating system are of three general types: stomata or valves on the surfaces of leaves and young shoots; ventilating pores, which occur in certain ærial roots; and lenticels, pores in the older wood, whose presence can be noted by the unaided eye in almost any plant.

The earlier naturalists were quite in the dark as to the function of these pores. GUETTARD, who described them in 1745, designated them merely as

glands ; DE CANDOLLE (1826) thought they were a kind of bud, from which roots later put forth ; UNGER (1838) believed they had something to do with reproduction ; but as early as 1809, DUPETIT-THOUARS declared their purpose was ventilation, and the work of several students during the next half century demonstrated that this opinion was well founded.

Although he misunderstood their purpose, DE CANDOLLE gave them the name which they now bear, because of the resemblance of one of these pores to a minute, bi-convex lens, in general shape.

They are usually found on both stem and root of a plant, but may also appear on leaf-stems, and sometimes on fruits—the walnut and horse-chestnut, for instance.

Yet, in spite of their widespread distribution, they have been sought in vain on some plants. They appear not to exist on the European grape *(Vitis vinifera)*, although they can easily be seen on its close relative, the Scuppernong grape of the southern United States *(Vitis rotundifolia)* ; they have been not discovered on the Italian honeysuckle, the trumpet creeper *Tecoma* radicans, some species of Clematis, the Philadelphus or mock-orange, Deutzia, *Rubus odoratus*, etc.

It has been explained that these plants are provided with a regularly repeated annular formation of the bark, and therefore do not stand in such need of lenticels for the purpose of ventilation. But this hypothesis carries little weight, when one finds that other plants with similar bark have lenticels. Why, for instance, should the climbing honeysuckles lack these organs, while those which do not climb possess them ? And why are they present in the bittersweet *(Solanum duleamara)*, the Boston Ivy *(Ampelopsis)* the Wistariar, and other plants which have habits of growth and formation of bark similar to those above referred to, which lack lenticels.

Another difficulty in the way of believing the idea once held, that they are indispensable to the respiration of the plant, is the fact that during a considerable part of the year they are partly or wholly closed by the formation of a layer of cork underneath them. This is particularly the case in winter, the plant's resting period, when little ventilation is necessary ; but observers have found that this closing of the ventilators often begins in early summer, so that spring is the only season when the lenticels are functioning.

Further, it has been discovered that the lenticels are in some cases permanently closed ; they look normal from the outside, but are in reality of no value whatever to the plant for breathing.

These facts have led many plant physiologists to think that although the lenticels undoubtedly do fulfil in many cases the function of breathing pores for the bark, that is not really their purpose. Such a solution of the problem accords well with the interpretation of nature of certain scientists, who hold on philosophical grounds that nothing should be said really to have a purpose.

EXPERIMENTAL TESTS.

But whether breathing is the purpose of the lenticel or not, one can very easily demonstrate that it actually does act in most cases as an outlet for the plant's ventilating system. A favourite laboratory experiment is to seal up one end of a stick, seal a tube around the other end, and then force air under pressure through the stick, submerged in water. A string of fine bubbles will issue from every lenticel. The fact can be demonstrated even more easily, merely by sealing both ends of a short stick and then submerging it in warm water ; the warmth will in most cases be sufficient to expel the cooler air within the stick, and bubbles will appear at the lenticels.

Sometimes these openings reach a length as great as a third of an inch ; in other cases, as in the bark of the sycamore *(Platanus)*, they are so small as

to be almost microscopic. In twigs they are commonest on the under side, and the number increases somewhat regularly with the age of the wood. On a piece of elm branch 20 centimetres long, HABERLANDT found the number of lenticels as follows :—

		First Year.	Third to fifth year.	Tenth to fifteenth year.
Upper side	...	55	66	95
Under side	...	70	78	96

The lenticels usually begin formation under the surface, frequently beneath one of the stomata, in which case, as the epidermis is gradually replaced by cork (i.e. bark), the lenticels take the place of the stomata as ventilating pores.

Structurally, the lenticel may be described in simplest terms as an opening through the bark which is filled, in most cases, with a mass of powdery packing-cells, so loosely arranged that air can easily pass between them. In wet weather these cells usually expand and protrude from the opening, so that the lenticel comes to resemble a wart.

This response to the humidity of the outside air gives the clue to another function which the lenticels share with the stomata—to aid in regulating the transpiration of the plant. Indeed, DEVAUX, one of the latest botanists to give the subject careful study, concludes that it is more correct to say they regulate the amount of moisture in the plant than to ascribe ventilation as their chief function.—JOURNAL OF HEREDITY.

VALUING AGRICULTURAL ESTATES AND LANDS.

The first step to be taken in assessing an agricultural estate on the basis of its capitalisation value is to determine the precise gross return from the estate. For this purpose a question form is employed which takes into account the details of the estate and thus enables the assessor to obtain an exact knowledge of the concern of which he has to determine the average gross returns for the last 5 to 10 years. Such returns will be also realizable in the future as they correspond to the general average of the region. The writer reproduces the question form employed for this purpose by the Swiss Peasants' Secretariat.

The second step consists in the choice of the coefficient for the determination of the capitalization value from the table of these coefficients, taking into account the type of farming, the orientation of the production and the size of the concern to be valued.

This coefficient may be liable to small variations if the estate in question, owing to certain peculiarities, cannot be placed under any of the established heads in the table. On multiplying the gross income by the factor for the capitalisation value, the average capitalisation value of the estate is obtained (land capital, building-capital, improvement-capital, cultivation-capital) the product of the combination of all the factors of production taking part in the agricultural concern and employed in accordance with local methods.

To determine the capitalisation value of the land itself, it is necessary to deduct from the agricultural revenue the returns from the buildings. For dwelling houses one takes into account the capitalisation value (the capitalised difference between rent and outlay, plus the value of building material after demolition); for farm buildings, the value of construction is considered,

and both are determined in relation to the economical value of the buildings. For the determination of the capitalisation value of each particular lot of ground, 3 different methods may be employed: the method based on the commercial value, the natural method, and the combined method. The method based on the commercial value establishes the comparison between the capitalisation value and the commercial value of the estate as a whole, and with the help of this comparison and of the known commercial value of the lot in question, the capitalisation value of this lot is determined. The natural process starts from the average capitalisation value per acre of the estate, from which the estimate of the lot in question is established according to its natural and economic conditions; this is done with greater exactitude by the aid of a system of points devised by PROF. LAUR, that is the number of points to be assigned is reckoned either according to the object of the assessment, or according to the average conditions of the agricultural property in question, or the average and customary conditions of the region. The combined method (a combination of the two previous methods) first of all establishes the numerical ratio between the average capitalisation value per acre of the estate and its average commercial value per acre. Then it determines the average commercial value per acre of the lots belonging to the group of fields which include the lot to be valued. By aid of this latter value is then calculated, according to the method based on the commercial value, the average capitalisation value per acre of the land in this group of fields, which serves in its turn as the point of departure for valuing by the natural process the particular lot in question. Applying the point system one then compares, in the first place, the lot of ground to be valued with the average of all the lots belonging to the group of fields in question.

The capitalisation value of the bare land of an agricultural estate can be obtained by deducting from the total capitalisation value of the estate the building-capital plus the cultivation-capital; it may, however, be directly calculated by the aid of the coefficients of the capitalisation value of the soil established *ad hoc* by the Swiss Peasants' Secretariat; coefficients which represent the relation between the capitalisation value of the soil and the gross revenue from the estate. To determine the capitalisation value of the bare land of each particular lot, the method based on the commercial value and the combined method based on the point system may here be employed with advantage. If the capitalisation value of entire communes is to be estimated, one must first, as previously, determine the total gross revenue of the commune, then choose the average coefficient of capitalisation value, taking into account the average conditions obtaining in the commune as regards the type of farming, the trend of production, and the size of estates; multiplying the gross revenue by this average coefficient, the capitalisation value of the entire commune is obtained. In order to calculate by the aid of this value, the capitalisation value of each particular lot, one may, as before, employ 3 methods. As general rule the method based on the commercial value may be employed; the natural method is particularly advisable when the estates are isolated and have clearly defined boundaries, whilst the combined method is best employed when the buildings are clustered into villages, and where the demesne is much scattered. Likewise, the capitalisation value of the bare land of an entire commune can be calculated directly with the aid of an average coefficient of the soil's capitalisation value.—

BULL. INT. INST. OF AGRIC.

THE PREVENTION OF SOIL WASH.

The greatest waste in Jamaica—among many forms—is what few think of, and we do not suppose people in towns ever give it a thought. It is the washing of soil, of good land, into the rivers and gullies and then into the sea.

People will quarrel and go to court over an inch of land along their lines or boundaries, and yet view with equanimity the heavy rains washing away inches deep of soil from the surface of their land, wherever it is bare and not drained.

After the recent heavy rains we noticed on some hillside cultivations, not trenched, little gullies all over, some plants washed bare or washed out, and at the foot of the hill large banks of soft soil which had been washed down: tons of good earth had probably already been washed into stream; then the rains stopped and left the big bank of good earth on the bank of the stream; an hour or two more of heavy rains and this would have gone, to be replaced by another bank of soil washed down.

Land costs money; at this particular place the land cost small settlers £5 per acre. There were acres of it, and that the best of it being washed away during the heavy rains.

We saw another piece of land very steep, but thoroughly trenched; every chain had a 2 ft. deep trench across the hillside; every trench was nearly up to the top with soft soil washed into it, but there was no more in the bottom trenches than in the top ones; there was no bank of earth heaped up at the foot of the hill, practically none had been washed away.

When the rain was over the trenches would be cleaned out and the nice earth flung—not on the edges of the trenches—but all over the land.

The owner of this particular land had unfortunately just cleaned out his bananas in order to give them a last forking for the season, and he had failed to leave the weedings in a long line between the rows which also would have helped to prevent the wash; the weeds were in scattered heaps.

Such rains (of August and September) were, of course, unexpected. It is good to have the land covered when the heavy seasons rains ought to come. Green cover crops are a help in this way. In heavily shaded places bananas, with cocoa or coffee on, however, cowpeas and other crops for green dressings will not grow in heavy shade; we have not yet found one legume that will start in the shade, although some will grow in the shade of bananas if started when these are young and open. In such cases (hillsides), the weedings should rather be kept in long lines, rather than as is commonly done, in heaps.

Trenches or drains should be put in across every cultivated hillside, no matter the kind of cultivation.

TERRACING.

On steep hillsides, the terrace or platform system of working can be adopted with very great advantage. Thus the cultivator can work his field with greater facility and less exertion, as the outside of every platform or terrace is a foot-path so that he does not need to hand on to the hillside in going up and down, but walk easily along; the plants instead of having their roots exposed on the lower side when they are only growing with half a root system—as is usually the case with bananas, and partially the case with cocoa, less so with coffee but still to some extent—are growing on a flat; no trenches are required, the terrace does the drainage and catches all the wash; the terrace should always be tilted towards the hill not sloped with the hill; the washings can easily be cleared off and spread on the land.

The beginning of this system is sometimes noticed in the cultivation of yams on hillsides. Each yam is on a square platform or terrace; this platform should, however, be carried right along the hill, the yam hills being placed close in the line and wider between the rows. For bananas this is, we feel, the system for steep hillsides; the cocoa or coffee can then be planted very easily towards the inside of the platform against the hill. It is easy clearing off the earth after heavy rains from around the cocoa and widening the terrace if required.

This is not in any way a "discovery." It is not our idea. We read years ago of the wonderful terracing system on the mountain-sides in lands peopled by what we call "ancients," that is people who cultivated (a great deal better than we do now), thousands of years ago. Not only that, but these "ancients" had the most wonderful irrigation systems and irrigated the driest and most arid hillsides.

In Italy at the present day the lime and orange trees are grown on terraces along rocky hillsides.

In the Canary Islands the "Dwarf" bananas that are so much exported to the United Kingdom are grown on terraced hillsides which are irrigated. We have had this idea in mind for Jamaica for years and have spoken about it for years but have not had it thoroughly tested; indeed only have seen the plan carried out in a "sort of way."

It is a plan, however, that is now written about for the purpose of criticism before anyone adopts it.—JAMAICA AGRIC. SOC. JOURNAL.

SUGGESTIONS FOR CURING COCOA.

The following suggestions for curing cacao and obtaining nice round beans with fine aroma and good break are given as an appendix to the Report of the Trinidad Cacao Commission.

When the pods are broken in the fields the entire contents, including the placenta or guts, must be taken to the curing house and put to sweat along with the cacao, and only removed when the cacao is put into the drying houses. The sweating ought to be from 3 to 4 days in the box, then turned over into another for two days before being turned out into the drying houses. Of course, when drying space is required, sweating for shorter periods may become necessary.

When the cacao is in the sweating boxes it ought to be well covered up with banana leaves at each sweating, and these leaves ought not to be thrown away, but used over and over again along with fresh leaves as the curing of the crop progresses and only be turned into manure when the crop is finished. Removable covers to the sweating boxes cause quicker fermentation. The placenta or guts make a splendid manure, and ought to be put in the manure heap and used when planting out supplies of cacao, cedar or any other trees, as it makes them grow rapidly. Placenta when thoroughly dried is saleable and would pay to export could it be pressed into bales so as to economise in freight and cost of bagging. The foregoing suggestions will undoubtedly assist in improving the quality of the cacao cured, but, of course, in rainy weather discretion must be used as to the period of sweating as on no account must black cacao be turned out. Claying cacao ought to be avoided as much as possible, and when necessary only sufficient to give a uniform colour ought to be used.—JAMAICA AGRIC. SOC. JOURNAL.

MARKET RATES FOR TROPICAL PRODUCTS.

(From Lewis & Peat's Latest Monthly Prices Current.)

	QUALITY.	Quotations.
ALOES, Socotrine cwt.	Fair to fine	40/ a 50/
Zanzibar & Hepatic ,,	Common to good	40/ a 70/
ARROWROOT (Natal) lb.	Fair to fine	5d
BEES' WAX cwt.		
Zanzibar Yellow ,,	Slightly drossy to fair	£7 10/ a £7 15/
East Indian, bleached ,,	Fair to good	£8 10/a £8 12/6
,, unbleached ,,	Dark to good genuine	£6 5/ a £7
Madagascar ,,	Dark to good palish	£7 15/ a £8 2/6
CAMPHOR, Japan lb.	Refined	1/7 a 1/8
China cwt.	Fair average quality	155/
CARDAMOMS, Tuticorin	Good to fine bold	5/9 a 6/
per lb.	Middling lean	4/8 a 5/4
Malabar, Tellicherry ,,	Good to fine bold	5/9 a 6/3
Calicut ,,	Brownish	3/9 a 5/3
Mangalore ,,	Med Brown to good bold	4/ a 6/4
Ceylon, Mysore ,,	Small fair to fine plump	4/ a 6/4
Malabar ,,	Fair to good	3/2 a 3/4
Seeds E. I & Ceylon ,,	Fair to good	4/ a 4/3
Ceylon "Long Wild" ,,	Shelly to good	2/3 a 3/6 nom.
CASTOR OIL, Calcutta ,,	Good 2nds	3½d
CHILLIES, Zanzibar cwt.	Dull to fine bright	50/ a 60/
Japan ,,	Fair bright small	60/ a 70/
CINCHONA BARK.—lb.	Crown, Renewed	3⅞ d a 7 d
Ceylon	Org. Stem	2d a 6d
	Red Org. Stem	1¾ d a 4½d
	Renewed	3d a 5¼d
	Root	1⅞d a 4d
CINNAMON, Ceylon 1sts.	Good to fine quill	1/3 a 1/9
per lb. 2nds.	,, ,,	1/2 a 1/7
3rds.	,, ,,	1/1 a 1/6
4ths.	,, ,,	1/ a 1/3
Chips.	Fair to fine bold	2d a 4d
CLOVES, Penang lb.	Dull to fine bright pkd.	1/ a 1/2
Amboyna ,,	Dull to fine	10d a 10½d
Zanzibar ,,	Fair and fine bright	5⅞d a 6¼d
Madagascar ,,	Fair	7d
Stems ,,	Fair	2d
COFFEE		
Ceylon Plantation cwt.	Medium to bold	Nominal
Liberian ,,	Fair to bold	63/ a 80/
COCOA, Ceylon Plant. ,,	Special Marks	81/ a 88/6
	Red to good	73/ a 80/6
Native Estate ,,	Ordinary to red	42/ a 68/
Java and Celebes ,,	Small to good red	30s a 93s
COLOMBO ROOT ,,	Middling to good	15/ a 22/6
CROTON SEEDS, sifted ,,	Dull to fair	42/6 a 47/6
CUBEBS ,, ,,	Ord. stalky to good	130/ a 150/
GINGER, Bengal, rough ,,	Fair	19/
Calicut, Cut A ,,	Medium to fine bold	75/ a 85/
B & C ,,	Small and medium	35/ a 74/
Cochin, Rough ,,	Common to fine bold	22/6 a 27/
	Small and D's	20/
Japan ,,	Unsplit	20/
GUM AMMONIACUM ,,	Ord. Blocky to fair clean	40/s a 72s 6d
ANIMI, Zanzibar	Pale and amber, str. srts	£14 10/a £16 10/
,, ,, ,, little red		£11 a £12
,,	Bean and Pea size ditto	70/ a £11
,,	Fair to good red sorts	£8 10/ a £10 10/
,,	Med. and bold glassy sorts	£5 10/ a £7 5/
Madagascar ,,	Fair to good palish	£4 a £8
,, ,, red		£4 a £7
ARABIC, E. I. & Aden ,,	Ordinary to good pale	26/ a 32/6
Turkey sorts ,,	,, ,,	37/ a 57/6
Ghatti ,,	Sorts to fine pale	17/ a 27/
Kurrachee ,,	Reddish to good pale	22/6 a 32/6 nom.
Madras ,,	Dark to fine pale	20/ a 30/ nom
ASSAFŒTIDA ,,	Clean fr. to gd. almonds	£6 a £6 10/
	com. stony to good block	40s a £5
KINO lb.	Fair to fine bright	6d a 1/5
MYRRH, Aden sorts cwt.	Middling to good	57/6 a 67/6
Somali ,,	,, ,,	52s 6d a 55s
OLIBANUM, drop ,,	Good to fine white	45s a 50s
,,	Middling to fair	35s a 40s
pickings ,,	Low to good pale	15/ a 27/6
siftings ,,	Slightly foul to fine	18s a 25s
INDIA RUBBER lb.	Fine Para smoked sheets	2/4
Ceylon, Straits, ,,	Crepe ordinary to fine	2/2
Malay Straits, etc. ,,	Fine Block	2/4½
	Scrap fair to fine	1/8 a 1/9
Assam ,,	Plantation	1/10
,,	Fair 11 to ord. red No. 1.	1/3 a 1/6
Rangoon ,,	,, ,, ,,	1/2 a 1/4

	QUALITY.	QUOTATIONS.
INDIA RUBBER lb.		
Borneo ,,	Common to good	9d a 1/3
Java ,,	Good to fine red	1/3 a 1/6
Penang ,,	Low white to prime red	9 d a 1/4
Mozambique ,,	Fair to fine red ball	1/9 a 2/1
,,	Sausage, fair to good	1/9 a 2
Nyassaland ,,	Fair to fine ball	1/9 a 2
Madagascar ,,	Fr. to fine pinky & white	1/4 a 1/6
,,	Majunga & blk coated	1/ a 1/2
,,	Niggers, low to good	6d a 1/6
New Guinea ,,	Ordinary to fine ball	1/4 a 1/7
INDIGO, E.I. Bengal ,,	Shipping mid to gd. violet	3s 3d a 3s 8d
,,	Consuming mid. to gd.	2s 9d a 3s 2d
,,	Ordinary to middling	2s 4d a 2s 9d
,,	Mid. to good Kurpah	1s 11d a 2s 5d
,,	Low to ordinary	1s 6d a 1s 9d
,,	Mid. to fine Madras	1/11 a 2/9
MACE, Bombay & Penang ,,	Pale reddish to fine	2/4 a 2/6
per lb.	Ordinary to fair	2/ a 2/2
Java	,, ,, good pale	2/ 1 a 2/4
Bombay	Wild	1/
NUTMEGS,— lb.		
Singapore & Penang ,,	64's to 57's	9½d a 10½d
	80's	7½d
	110's	6½d
NUTS, ARECA cwt.	Ordinary to fair fresh	17/6 a 20/
NUX VOMICA, Cochin	Ordinary to good	13/6 a 15
per cwt. Bengal	,, ,,	12/
Madras	,, ,,	12/ a 13/
OIL OF ANISEED lb.	Fair merchantable	5/2
CASSIA ,,	According to analysis	2/8 a 2/11
LEMONGRASS oz.	Good flavour & colour	2¼d
NUTMEG ,,	Dingy to white	1½d a 1 ¾d
CINNAMON ,,	Ordinary to fair sweet	4d a 1s 5d
CITRONELLE lb.	Bright & good flavour	1/6½
ORCHELLA WEED—cwt.		
Ceylon ,,	Fair	10/6
Madagascar ,,	Fair	10/6
Zanzibar ,,	Fair	10/6
PEPPER—(Black) lb.		
Alleppy & Tellicherry	Fair	5d
Ceylon ,, ,,	Fair to fine bold heavy	5d a 5⅝d
Singapore ...	Fair	4½d
Acheen & W. C. Penang	Dull to fine	5d a 5½d
(White) Singapore ,,	Fair to fine	8½d a 8¾d
Siam ,,	Fair	8¼d
Penang ,,	Fair	7½d
Muntok ,,	Fair	9d
RHUBARB, Shenzi ,,	Ordinary to good	2/ a 4/
Canton ,,	Ordinary to good	1/10 a 3/6
High Dried ,,	Fair to fine flat	11d a 1/1
	Dark to fair round	9 d a 10d
SAGO, PEARL, large—cwt	Fair to fine	18/
medium ...	,, ,,	16/
small ...	,, ,,	13/ a 14/
Flour ..	Good pinky to white	10/ a 11
SEEDLAC cwt.	Ordinary to gd. soluble	65/ a 75/
SENNA, Tinnevelly lb.	Good to fine bold green	5d a 8½d
	Fair greenish	3d a 4½d
	Common specky & small	1½ d a 2½d
SHELLS, M. o' PEARL—		
Egyptian cwt.	Small to bold	72/6 a £6
Bombay ,,	,, ,,	85/ a £6 10
Mergui ,,	Chicken to bold	£8 12/6 a £145
Manilla ,,	Fair to good	£7 17/6 a 13 10
Banda ,,	Sorts	50/ nom.
Green Snail ,,	Small to large	70/ a 85/
Japan Ear ,,	Trimmed selected small to bold	47/ a £5 15
TAMARINDS, Calcutta...	Mid to fine bl'k not stony	14/ a 15/
per cwt. Madras	Inferior to good	6/ a 10
TORTOISESHELL—		
Zanzibar & Bombay lb.	Small to bold	12/ a 26/
	Pickings	6/6 a 19/
TURMERIC, Bengal cwt.	Fair	12/ a 13/
Madras ,,	Finger fair to fine bold	14/ a 16/
Do. ,,	Bulbs ,, ,, bright	12/ a 13/
Cochin ,,	Finger fair	13/ nom.
	Bulbs ,,	11/6 a 12/
VANILLOES— lb.		
Mauritius ... 1sts.	Gd. crystallized 3½a 8½ in.	9/6 a 15/
Madagascar ... 2nds.	Foxy & reddish 3½a ,,	9/ a 12/
Seychelles ... 3rds.	Lean and inferior	9/ a 9/6
VERMILLION ... lbs.	Fine, pure, bright	2/7
WAX, Japan, squares cwt.	Good white hard	47/6

AN ILLUSTRATED HANDBOOK OF

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With Special Reference to Ceylon,

By H. F. MACMILLAN, F.L.S.,

Superintendent of Botanic Gardens, Ceylon.

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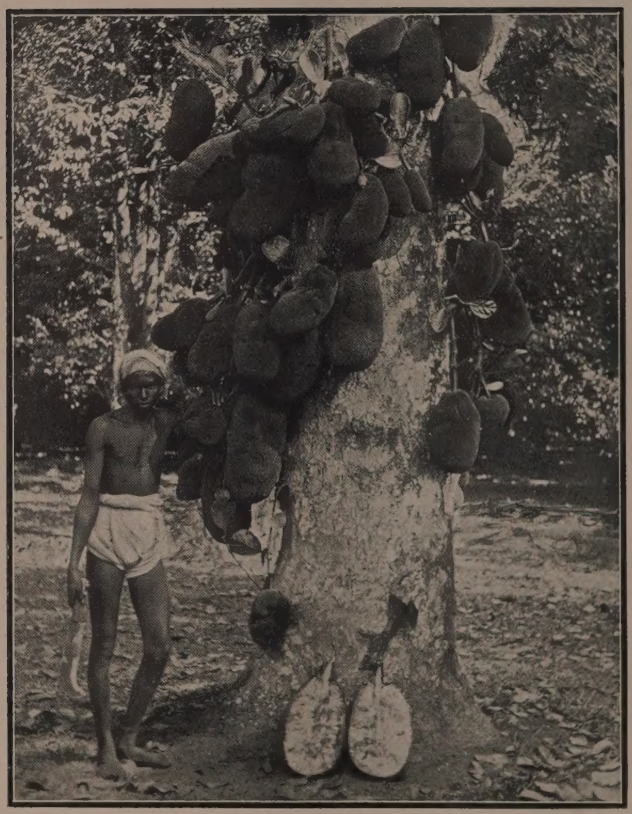

JAK TREE (*ARTOCARPUS INTEGRIFOLIA*).

The fruit, boiled and eaten as a vegetable, forms an important article of food with natives of the Eastern Tropics, while the tree yields a first-class timber much used for cabinet work and practically equal to Mahogany. The fruit grows to an enormous size, and usually possesses an overpowering odour, which however is not objected to by persons eating it. The jak is becoming scarce in Ceylon, and efforts should be made to extend its cultivation.

H. F. M.